SACRAMENTO STOCKTON SAN FRANCISCO BAY AREA

CORRIDOR STUDY

no maps

SCHEMATIC PHASE REPORT

prepared for

Business and Transportation Agency, State of California
Senate, State of California
United States Department of Transportation
Metropolitan Transportation Commission
Sacramento Regional Area Planning Commission
San Joaquin Council of Governments

May 21, 1973

Alan M. Voorhees & Associates, Inc.-in association with-
Development Research Associates; Eckbo, Dean, Austin & Williams,
Kaiser Engineers.

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STATE OF CALIFORNIA

RONALD REAGAN, Governor

BUSINESS AND TRANSPORTATION AGENCY

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June 8, 1973

Policy, Steering and Technical
Resource Committee Members

Gentlemen:

The first phase of the Sacramento-Stockton-San Francisco Bay Area Corridor Study required the consultant to prepare a schematic report that presents the methodology and some general transportation alternatives which will be elaborated upon and/or refined in subsequent cycles of the Study. The report is divided in two main sections; 1) an executive summary which highlights the main policy issues, assumptions and findings, and 2) the detailed background work required in the Study.

The principal objective of the schematic report is to provide an early, yet substantive review of the technical work being done by the consultant so that useful feedback and criticisms from all interested groups can be obtained. A careful review of this report is necessary by all participants so that all the major policy issues and assumptions will be addressed. The report does not develop full transportation programs, but rather outlines the major components needed to develop a complete program in cycle two.

The report covers a wider ground, both geographically and in subject matter, than has been the norm of previous transportation studies within the State. It attempts to deal with local issues and region-wide concerns, and with shorter and longer term needs. The report presents a preliminary overview of the principal environmental, economic, social and transportation considerations that will influence corridor transportation decisions.

We look forward to your comments, criticisms, suggestions for change, and views on more detailed study for the additional cycles.

Sincerely,

R W Holdsworth

RAYMOND W. HOLDSWORTH
Project Manager

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I. SUMMARY AND FINDINGS

I.A. Introduction

This study has its roots in a mutual interest in intercity travel in the region on the part of both the California Business and Transportation Agency and the State Senate. In the summer of 1970 an Assembly resolution was introduced to study a BART extension from the Bay Area to Sacramento. Following an initial examination of the problem and priorities, this broader study of intercity transportation problems and opportunities was formulated. Financial support is provided by the Business and Transportation Agency, the California Senate, and the U.S. Department of Transportation. In addition, in-kind services are being contributed by the Metropolitan Transportation Commission (Bay Area), the Sacramento Regional Planning Commission and the San Joaquin Council of Governments.

Urban and intercity travel have long been treated as unrelated areas for study, policy making, investment and operation. Promotional policies and regulations for intercity travel for various modes have proceeded without recognition of its impact on urban areas. Similarly, urban transportation concerns have rarely considered the effect of urban transport programs on intercity travel.

This study of intercity and long-distance travel in the Sacramento-Stockton-San Francisco Bay Area Corridor represents an understanding of the increasing importance of the urban-intercity interface and the need for coordinated transportation planning and implementation not only at the metropolitan level but among the metropolitan areas as well. The focus of this study will be to equally evaluate all forms of transportation for this corridor.

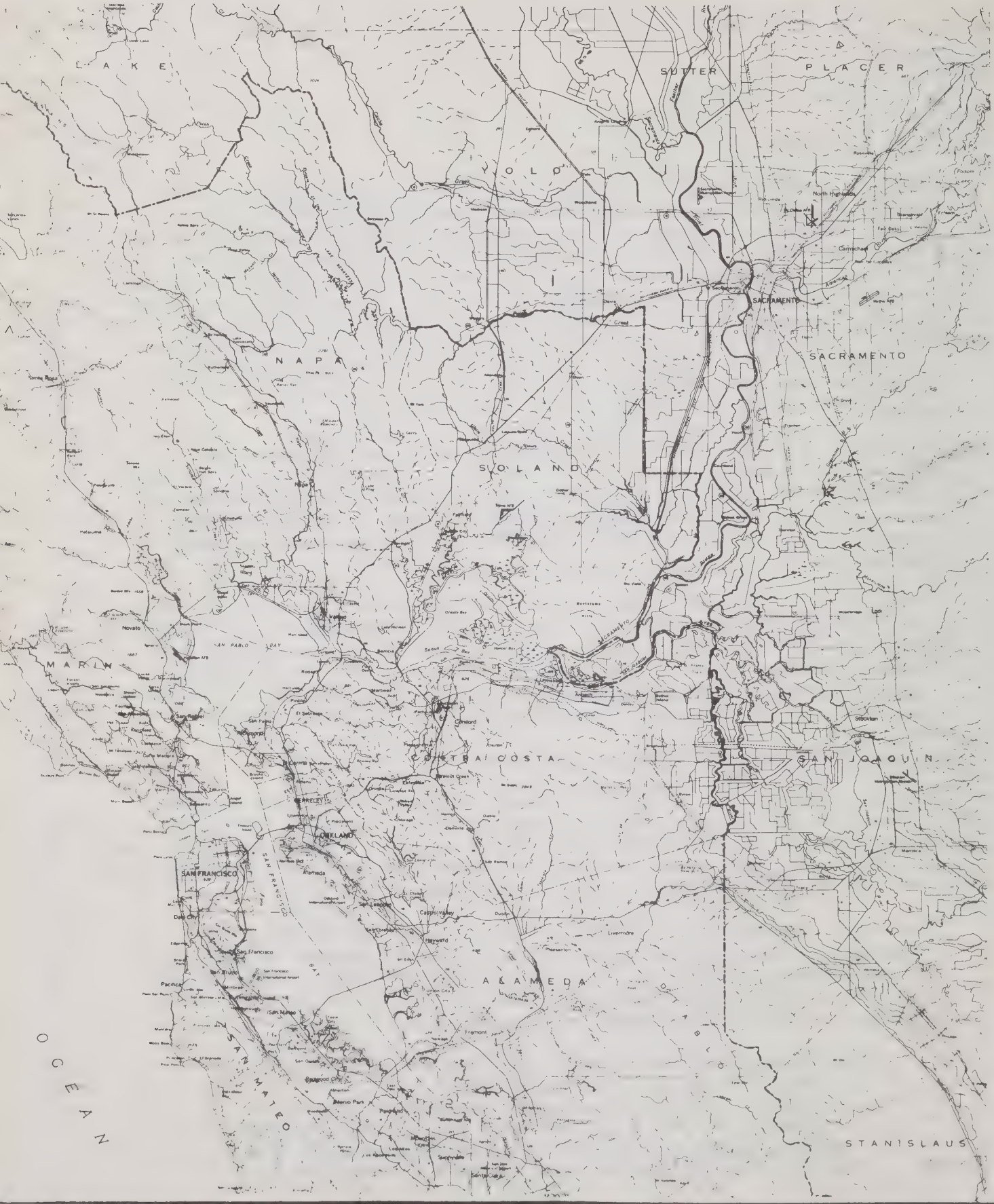
I.B. Study Objectives and Policy Issues

The objective of this study is to decide whether, how and when to serve the increasing intercity mobility requirements of those who are or will be living and working in the Study Region--and how to do so in a manner which achieves a satisfactory balance between improved transportation service, socioeconomic effects and environmental impacts at a resonable cost.

While the transportation situation at the present time is not critical, a number of factors point toward a rapid increase in intercity travel which in the absence of a coordinated transportation program, will result in significant reductions in today's level of service and lead to pressures for ad-hoc solutions.

- Total Regional Population of 6 million is expected to expand to between 8 and 8.7 million by 1995.

- As a result of increasing affluence and assuming no dramatic shift in public policy or traveler behavior average weekday vehicle trips during this same period will almost double.



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SACRAMENTO-STOCKTON-SAN FRANCISCO BAY AREA-CORRIDOR STUDY

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- Depending upon the land development patterns within the Region the intercity component of travel could increase from 200% to as much as 240%.

- While no estimates have yet been prepared, weekend recreational corridor travel is expected to expand at even higher rates than those indicated above.

- The automobile dominates intercity travel in this corridor. For example, 90 percent of the Bay Area-Sacramento travel is by car, 8 percent by bus and 2 percent by air. The automobile appears to be capturing an increasing share of this travel.

- No ongoing public institution has a responsibility for planning, operating, or funding intercity-transit.

Clearly, the current highway capacity of the corridor to handle the scale of movements indicated by these factors will be inadequate. Both weekend and weekday congestion is already building up at peak periods. The ability of existing highway and airport systems to handle dramatic volume increases is limited, and they will operate in the future with declining effectiveness.

The available public ground transportation services are minimal both in terms of service and capacity and there are no plans to significantly increase the capacity or service of any of the corridor transport systems. The requirement to modify these systems, either in the form of increased capacity to service the anticipated mobility desires or management actions to regulate the magnitude and freedom of these movements, will become increasingly apparent and urgent in the near future.

At the same time, substantial additions to the existing systems, construction of new systems or regulation of existing systems must be viewed along with their associated impacts--both positive and negative. Tradeoffs will have to be made between the various methods of accommodating or not accommodating increased travel and the attendent economic, social and environmental impacts. It is the purpose of this study to define and where possible measure these interrelationships so that basic policy choices on a course of action can be made in a context of full knowledge concerning the pros and cons of a wide range of alternative.

Based upon discussions and meetings with the participants during this first 3 month phase of the study, the key policy issues about which decisions will be required and information must be provided, can be grouped into four broad categories.

- The definition of "need" for intercity transportation improvements
- The feasibility and desirability of providing significant intercity public transit service
- The desired size and shape of the region's development
- The desired environment in the region.

Is There A Need For Intercity Transportation Improvements In The Study Region?

The question of "need" revolves around a series of sub-issues; however, it must be noted that "need" is a value-related issue and subject to many interpretations and definitions. Need for whom to do what? Need of what service levels? By what mode? What are the alternatives and their impacts? One thing is clear and that is that the need for a facility or service is not synonymous with its usage. To respond to this issue the study must carefully distinguish between the two.

Should There Be A New Major Public Intercity Transportation System In The Study Area?

The feasibility and desirability of an intercity transit system is a major question, the answer to which depends on a combination of technical and "policy" information. The technical questions include the cost of constructing and operating a new system and how many people would use it if built and what the beneficial effects would be. "Policy" questions include who would pay for a new system, and who would benefit from it? What degree of patronage justifies the expense? The importance of the impacts on the economy, the environment and on special user groups? Toward which group of travel needs should the system be oriented--business, government, recreation--or should all groups be treated equally?

Should Any Regional Development Pattern Be Adopted As Policy And Carried Out By Government, Or, Should Regional Development Be Left Unplanned? If Planned Development, What Plan?

Currently, development is an accumulation of individual decisions by the public, employers, developers, utilities and government entities. On the one hand, individual development planning provides the creative spark for economic growth as well as satisfying the needs of the total community. However, this uncoordinated process leads to imbalances and important community objectives are often overlooked. The broader question regarding regional development planning suggests many other related questions, such as: Should new devel-

opments outside the urban periphery grow as bedroom communities, or have their own employment base? Should the development of well planned and controlled new towns in the region be encouraged? How can a regional development pattern be accomplished? What should individual municipal and county government do to direct and control growth? Should the transportation system be used to guide growth or should it serve growth?

What Are The Significant Environmental Resources And Problems In The Region And To What Extent Should They Be Protected Or Corrected?

Environmental degradation is a concern of increasing importance throughout the region which will significantly effect the type, location, and magnitude of both transportation services and land development. Can improved intercity transit affect air pollution? What is the appropriate use of the Delta? Will improved transportation strain development-related water and power supply needs? Should agricultural land for production be conserved?

A transportation issue directly related to the environment is whether or not intercity systems should attempt to serve the growing recreation travel demand. Recreation travel is a transportation problem with its own set of problems such as weekend congestion. On the one hand, improved accessibility to top recreational areas, such as Yosemite and Lake Tahoe, will make these attractions available to a larger section of the population. However, this may so overload the facilities that it produces serious ecological impact.

Despite the above catagorization it is obvious that the above ISSUE AREAS are interrelated and that decisions concerning one area could impact both positively or negatively on the others. Other issue areas will be uncovered during the study. In addition, it should also be clear that while a technical study can provide information on the type and magnitude of these impacts and interrelationships the resolution of any conflicts is a choice between values--a policy not a technical decision. For this reason the study provides information to the community and to the Policy Study Policy Committee to use in reaching their recommendations.

I.C. Purpose Of This Report

This report summarizes the work accomplished during the first 3 month cycle of the Sacramento-Stockton-San Francisco Bay Area Corridor Study. This is seen as the first of three successive cycles--each focusing in greater detail on the alternatives in respect to the policy issues. The function of this cycle is to "simulate" the entire study process--data gathering, development of alternatives, searching out of issues, structuring of the evaluation methodology and the evaluation of alternatives.

The principle objective of this report is to provide an early yet substantive

review of the technical work being done by the study in order to facilitate involvement, criticism and useful feedback from a broad range of public and private interest groups. Only through this type of continuous review will the study fully respond to the policy issues which must be addressed at the conclusion of the study. That does not mean that all the policy issues have been raised in this report. Additional issues will no doubt develop during the course of the study, particularly during the review process.

It is important to note that this report does not develop full multi-modal transportation improvement programs. Rather it develops and preliminarily evaluates a set of components consisting of routes, technologies and operating assumptions. In Cycle II complete program packages will be developed from these and other suggested components.

Sections I-VI of this report establish the environmental and socioeconomic framework for the study. This includes the alternative activity forecasts responding to complex internal and exogenous factors which influence the location of activity in space and time. In addition, the possible impact of increasing environmental awareness is considered.

Sections VII-XI present the preliminary descriptions of current intercity transportation patterns, existing and planned transport facilities. The future transportation needs based on the activity projections are then described along with components of comprehensive improvement programs. Baseline examples of these components--modes, technologies, route and operations are then tested and evaluated for their potential transport service function and market appeal compared with the automobile.

There are two prime reasons for using the automobile as the base for comparison. First, travel by automobile presently is by far the longest component of travel in the corridor. Secondly, the only comprehensive forecasted travel carried out so far, which covers the entire corridor area, is for vehicular traffic. This study is the California Statewide Transportation Study.

I.D. Cycle I Focus and Summary of Findings

The Focus On Intercity and Long-Distance Passenger Travel

This study will focus primarily on intercity passenger travel--travel between the major metropolitan areas in the study region and travel in and out of the study region. While no minimum distance limit can be set, particular attention will be paid to travel considered "external" by the existing urban studies--that is, travel crossing their study area cordon boundaries.

It has already been determined that recreation-related travel, while not strictly intercity, is an important form of long distance "external"

travel. It is a major contributor to congestion problems caused by inter-urban travel. For this reason recreation travel will be examined. However, solutions to recreation travel needs will be given secondary consideration unless they clearly contribute to the viability of improvement programs primarily designed for intercity travel.

The Intercity Transportation Market Potential

Total average weekday vehicle trips in the study area are forecast to increase from 11,700,000 in 1966 to between 21,300,000 and 25,500,000 in 1995. This increase of 180% to 220% in trip making assumes an overall population increase of 42% to 57%.

Within the 20 county study area, 85 percent of 19,800.000 trips would not cross county boundaries and are, with some exceptions, not prime candidates for intercity travel. If only the 11 counties which can reasonably be directly served with a system interconnecting San Francisco, Sacramento and Stockton the potential intercity market consists primarily of those trips between metropolitan areas. This is about one percent of all trips originating in the Bay Area and less than 10 percent of the Stockton and Sacramento generated trips. The total Sacramento-Bay Area intercity market appears to be about 212,000 trips per day. The Stockton-Bay Area corridor appears to be about 45,000. Figure S-2 shows the county to county 1995 travel movements which make up the Sacramento-Bay Area intercity travel market.

These potential divertible trips while small in terms of percentage of total movements in the study area consist of longer than average trips--from 20 to 80 miles compared with the average 9-mile work trip and the vast percentage of trips which are even shorter. Therefore, diversion of these trips can be significant in terms of reducing the total vehicle miles of travel in the corridor.

The actual penetration that any system makes in this intercity market is of course a function of its speed, location, and ease of access. In addition, some systems could also provide service to more local transportation needs depending primarily on station locations.

Focus On The Provision Of Intercity Public Transit Service

This study will focus primarily on the development, testing and evaluation of public transportation systems to serve the intercity market. In addition, of course, highway alternatives will be studied. Hoever, this focus recognizes that there are major questions concerning the feasibility of serving an intercity travel market with public transit. This focus is also in response to major socioeconomic objections to constructing more highways.

Figure S-2

1995 INTERCITY TRAVEL MARKET BY COUNTY*
SAN FRANCISCO - SACRAMENTO CORRIDOR
(000 person trips/weekday)

	SACRAMENTO	YOLO	SOLANO	NAPA
Sacramento	-			
Yolo	35.2			
Solano	11.1	26.5		
Napa	2.3	1.2		
Sonoma	2.7	0.8	26.0	
Marin	1.0	0.6	6.4	
Contra Costa	3.5	1.3	41.1	13.6
Alameda	1.9	0.8	15.0	8.5
Santa Clara	1.2	0.4	3.4	2.4
San Mateo	0.4	0.3	2.0	0.7
San Francisco	1.0	0.2	3.0	2.8

*Intercity trips within East Bay and Transbay trips excluded

Potential Intercity Transit Improvement Programs

A wide variety of potential improvement programs have been identified for possible Cycle II. These are grouped together in terms of availability and time required for implementation.

Short-Range--Bus Operations Improvements

- Improved Frequency of Service
- Increased Coverage of Express Bus Service
- BART/Bus Interface
- Bus-Auto Interface
- Exclusive Lanes
- Special Government Shuttles
- Group Rates
- Increased Charter Operations

Short-Range--Conventional Rail Operations Improvements

- Increased Frequency of Service
- New Passenger Routes
- Improved BART/AMTRAK Interface
- Convenient Schedules
- Special Recreation Trains

Short-Range--Conventional Air Operations

- Increased Frequency of Service
- Addition of Service from Other Bay Area Airports
- Improvement in Terminal Transit Access

Middle Range--Busways

- I-80 is the leading candidate for an exclusive right-of-way, given the difficulty of acquiring new rights-of-way. The possibility of establishing a busway on rail rights-of-way or power line rights-of-way will also be examined during the next phase.

Middle Range--High Speed Rail

- Improved passenger train technology could be instituted on any of the existing rail rights-of-way from a technical point of view. The Oakland/Sacramento Southern Pacific Line and the Santa Fe Line to Stockton via Pittsburg, and the Southern Pacific Line via Tracy are the major candidates from a market point of view. Freight conflicts, train controls, grade crossings and other safety questions are major impediments to be investigated.

Middle Range--Rapid Transit

- BART extensions for intercity service have been considered in conjunction with the BART extension studies currently underway. The BART studies are considering extensions to the Pittsburg/Antioch and Livermore/Pleasanton areas. Several possibilities exist for continuing BART beyond the extension terminals to Sacramento or Stockton and points in between.

- Richmond/Pinole/Vallejo/Fairfield/Davis/Sacramento (via a new bridge and then using Southern Pacific tracks).

- Concord/Benicia/Fairfield (Travis)/Davis/Sacramento (via a new bridge and then using Southern Pacific tracks).

- Pittsburg/Travis (Fairfield)/Davis/Sacramento (possibly via the proposed Pittsburg/Antioch bridge, then following the old Sacramento Northern right-of-way to Fairfield, than via Southern Pacific tracks).

- Pittsburg/Brentwood/Stockton (via Santa Fe tracks).

Each of these route alternatives could work in one of two possible operating configurations. First, a cross-platform transfer could be established at the outer terminus of the rapid transit extension where transfer would be made to special equipment for the intercity run. This equipment could be conventional rail equipment (for railroad compatability) or custom-designed intercity transit equipment.

An alternative would be "BART cars" which would make a continuous run on intercity routes, but also integrate into BART's metropolitan system. This would require dual gauge equipment or new tracks beyond BART at the BART gauge.

Middle Range Air Systems

- STOL equipment is becoming available, but equipment is not the major issue since available commuter-type aircraft could improve service if airports were more widespread. The major issue for STOL service in the Bay Area remains the location of STOL facilities. Several locations have been studied as at Richmond, Oakland, Concord, Livermore, Santa Rosa, as well as several sites in the Bay and on the San Francisco waterfront. A selection of these sites establishing a constellation of facilties with substantially improved access is fundamental to the success of the STOL concept.

Long-Range--Ground Systems

- Dual-Mode guideway combining transit and off-line capabilities is the ultimate evolution of the highway or busway. Any major highway could be converted to dual-mode given an available technology. However, dual-mode attractiveness revolves primarily around its high capacity. It is unlikely that dual-mode capacity would be provided by 1995, but certainly the leading candidate for first steps is the I-80 corridor between Sacramento and the Bay Area.

- High Speed Ground Tansportation such as the tracked levitated vehicles being developed by U.S. DOT require substantial patronage if capital costs are to be justified. This may suggest that a Bay Area to Sacramento system should be thought of as an extension of a San Diego to San Francisco run. Two routes suggest themselves within this assumption--a San Jose/Oakland/Fairfield (Travis)/Sacramento route assuming a major East Bay stop. The other route possible is a Central Valley alignment assuming a HSGT coming to the Bay Area from Los Angeles via Bakersfield-Fresno and connecting with the Bay Area via BART at Concord, crossing the Straits and continuing to Sacramento via Fairfield (Travis). It is possible that a HSGT technology may develop which could be justified within the study area alone. The San Jose/Oakland/Fairfield (Travis)/Sacramento route would be the prime candidate in terms of market although a Stockton route should be investigated. HSGT right-of-way requirement and station spacing suggest the possibility of alignments that are not within those of

existing transportation systems such as rail or highway rights-of-way. The abandoned Sacramento Northern right-of-way from Collinsville to Sacramento with a curve towards Travis (Fairfield) is a possibility for further investigation. Power line rights-of-way will also be investigated.

Potential Patronage of Intercity Transit Services

Selected components of potential improvement programs shown in figure S-3 were analyzed to determine the range of the intercity market which could be diverted from the highway. These were a selection of middle and long range technologies including the fastest technologies (HSGT and V/STOL) with few stops between the Bay Area and Sacramento as well as intermediate speed systems such as conventional rail, bus on exclusive right-of-way and BART extensions.

The results of these analyses for the San Francisco-Sacramento Corridor are shown in figure S-4 and discussed in the following paragraphs. It should be noted that the estimates only include persons diverted from auto. Each of the systems would also have patronage due to expansion of the market.

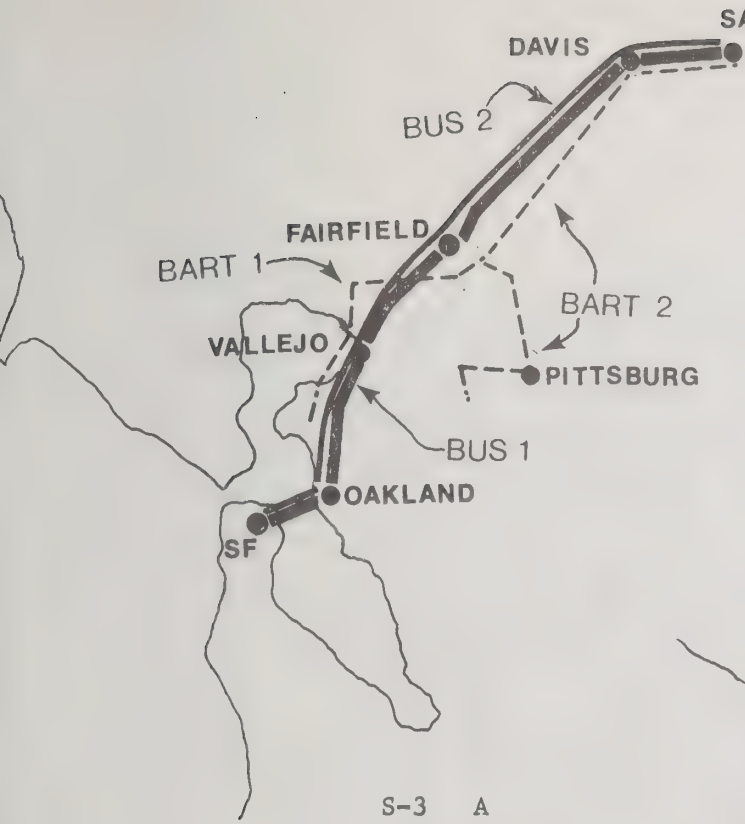
- While there remains considerable uncertainties in the dimensions of the future intercity travel market it appears to be large and varied enough to support transportation services.

- Of the three major sub-corridors in the Study Area (Bay Area-Sacramento, Bay Area-Stockton, Stockton-Sacramento) the largest, Bay Area-Sacramento sub-corridor has received major attention. The Bay Area-Stockton intercity corridor market appears to be about one-eighth the size of the Bay Area-Sacramento Corridor market.

- The high speed systems (HSGT and V/STOL) with few stops were the best competitors with the automobile and benefited the longest trips. They diverted the highest percentage of patronage for specific origins and destinations. Patronage estimates ranged from 2,000 to 23,000.

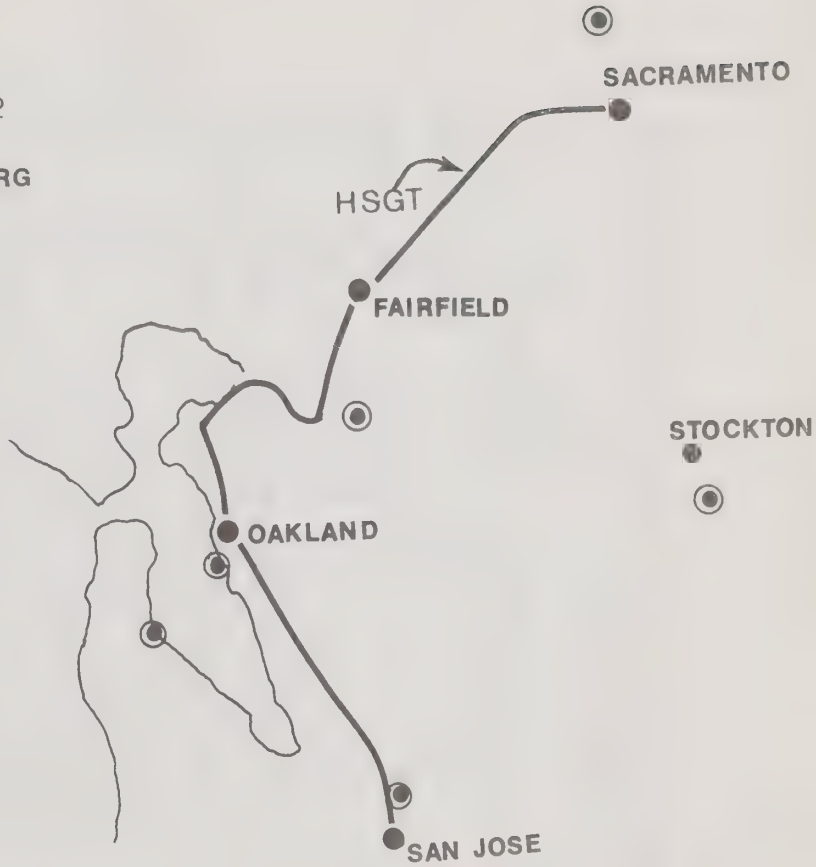
- The intermediate speed systems such as bus and BART extensions with more stops along the urbanized corridor between Oakland and Sacramento served a larger market since shorter trips were included. These systems were less competitive with the auto for some of the longer trips but attracted a larger total patronage. Patronage estimates ranged from 8,000 to 39,000.

- Contra Costa, Sacramento, and Solano Counties receive the best service in terms of the number of intercity trips served by the systems tested. Many of these trips are intermediate length



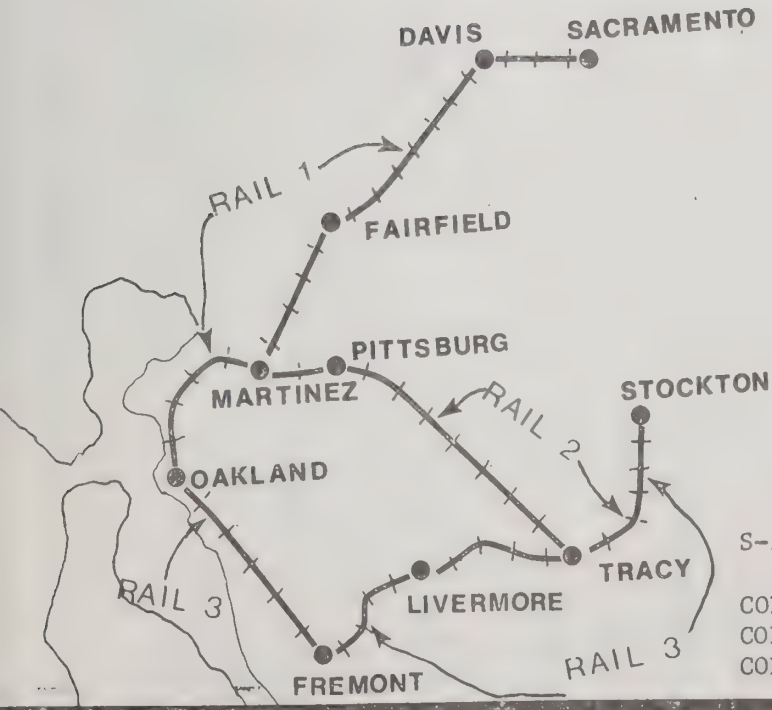
S-3 A

EXCLUSIVE BUS 1
EXCLUSIVE BUS 2
BART 1
BART 2



S-3 B

H.S.G.T.
V/STOL



S-3 C

CONVENTIONAL RAIL 1
CONVENTIONAL RAIL 2
CONVENTIOANL RAIL 3

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	SELECTED COMPONETS OF POTENTIAL IMPROVEMENT PROGRAMS	AMV	5-4-73	S13
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FIGURE S-4

PRELIMINARY ESTIMATES OF SYSTEM PERFORMANCE - SAN FRANCISCO CORRIDOR
1995 2-WAY WEEK-DAY INTERCITY PERSON-TRIP ENDS

	Intercounty Potential		% of Potential Diverted To:						
County	Num (000)	% Total	Bart 1	Bart	Conv Rail	Bus 1	Bus 2	HSGT	V/STOL
Sacramento	60	14	25.8	11.5	25.3	15.4	4.8	21.8	3.4
Yolo	67	16	18.3	4.9	6.2	16.4	0.6	0.7	0.4
Solano	129	29	17.6	2.1	16.4	14.8	-	11.6	-
Napa	32	8	18.0	-	28.2	13.2	-	11.4	
Sonoma	23	6	8.3	-	-	3.3	-	-	-
Marin	8	2	9.0	-	5.7	5.4	-	-	-
Contra Costa	59	14	2.1	2.3	24.0	2.4	1.7	2.0	1.7
Alameda	26	6	32.8	3.0	33.8	32.5	5.2	24.1	1.9
Santa Clara	7	2	-	-	-			49.5	4.7
San Mateo	4	1	37.6	6.9	30.8	24.4	7.1	22.5	6.9
San Francisco	7	2	30.0	4.1	35.0	28.0	10.0	35.5	3.4
Total	423	100							
System Patronage (000)8			36	8	38	29	3	23	2
Percent of Potential			17%	3%	18%	14%	1.6%	11%	1.1%

*Includes only those person trips diverted from auto

trips made along this corridor of urbanization.

- Systems with the greatest patronage, BART extension with 5 stops and Conventional Rail with 3 stops, will result in an estimated reduction in highway trips at Cordelia of up to 15,000 vehicles per day.

- Access service between trip origin or destination and the terminals of the system used for the line-haul portion of an intercity trip is the key to the attractiveness of the transit alternatives. Up to fifty percent of the total travel times can be getting to and from the line-haul system.

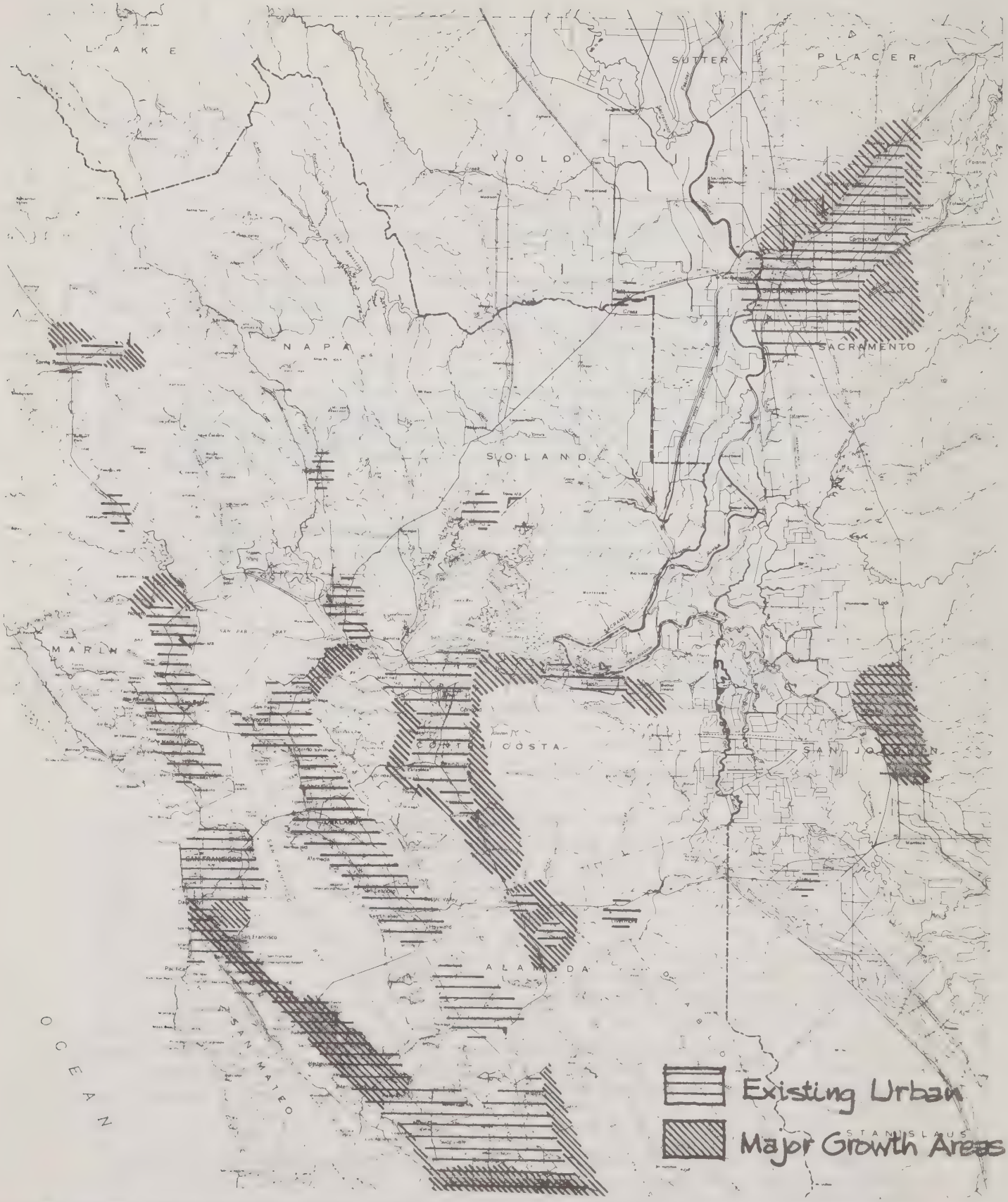
- Sensitivity analysis shows the patronage to be extremely sensitive to the competing speeds assumed for intercity highways and moderately sensitive to gas prices and transit terminal times and fares.

- The need for new modal interchanges is critical. Short-run issues include the need for improved BART-express bus transfer and BART/bus service to area airports. Any new system will be dependent on an access system for its success.

Focus On Alternative Futures

In all planning studies, there are both technical and policy uncertainties associated with forecasting, whether population/economic or travel. Much of this uncertainty is a result of possible changes in the future public policy environment itself based on changing or unpredictable values. In addition, aggregate socioeconomic forecasts contain technical uncertainties best witnessed by the recent necessity to revise population projections in California due to downward trends in birth rate and in-migration. Distributional forecasts also depend on estimates of future local policy such as zoning, taxation, provision of infrastructure, conservation sentiment or environmental awareness. As a result interest groups with different values or objectives may reasonably disagree about a forecast of future development based on a single set of assumptions about the future. Environmental protectionists'forecast may differ from those who are primarily interested in economic growth.

To escape this dilemma of developing alternative transportation solutions whose justifications rely on a single lon
present study is developing Alternative Futures--a range of population and employment projections by area which respond to differing assumptions and projections of what the future may hold. This approach permits those with



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S5

ALTERNATIVE FUTURE 1
low growth dispersed

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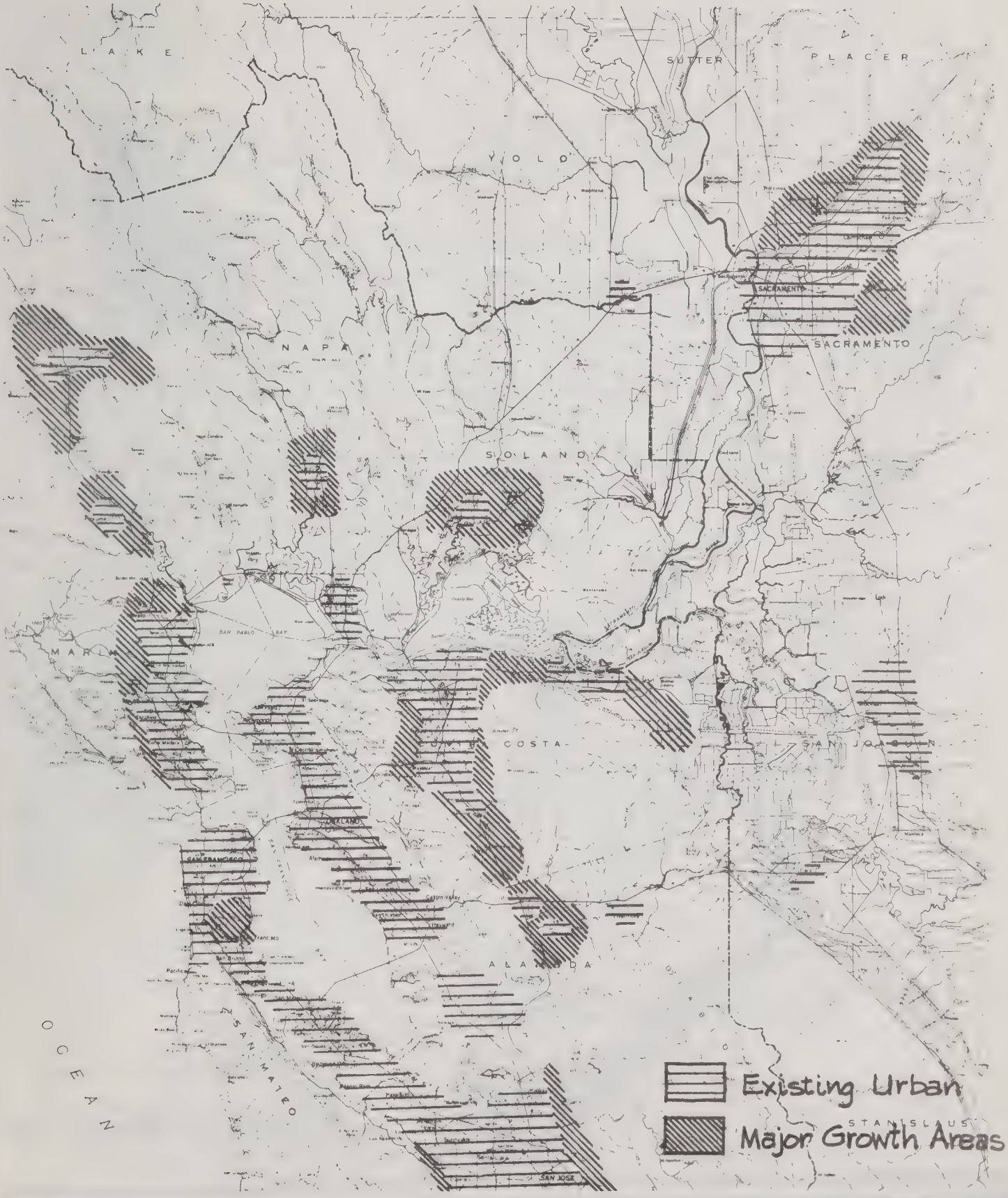

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SACRAMENTO·STOCKTON·SAN FRANCISCO BAY AREA·CORRIDOR STUDY

S6

ALTERNATIVE FUTURE 2
moderate dispersed

0 5 10 15 20 25mi

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DRA	4-27
EDAW	
KE	

S17

SSBACS

SACRAMENTO·STOCKTON·SAN FRANCISCO BAY AREA·CORRIDOR STUDY S7

ALTERNATIVE FUTURE 3
moderate city centered

0 5 10 15 20 25mi

AMV		
DRA	4-27	
EDAW		
KE		

S18

values and ideas to make use of the information developed. In addition, this approach also explicitly recognizes the risk of relying on a single projection as justification for making a policy decision.

Potential Alternative Regional Development Patterns

From the range of possible factors influencing socioeconomic patterns key variables have been chosen and placed into three combinations which appear to bracket the reasonable range of possible future development patterns. These are shown in figures S-5 to S-7 and described in summary fashion below. Figure S-8 summarizes the 1995 population and employment implications of each alternative future by county.

Alternative Future One-Low Dispersed--This is essentially a continuation of present trends and implies little change in the way of policy actions. Its likelihood will depend in large degree on the future course of the birth rate and state in-migration.

- Assumes a low growth rate
- Development would continue to concentrate in the southern portion of the Bay Area
- New growth will be dispersed at a low density into currently agricultural land

Alternative Future Two-Moderate Dispersed--This future reflects a possible increase in the birth and in-migration along with Bay Area regional policy changes to shift the emphasis of new development.

- Assumes a moderate growth rate
- A new emphasis would be placed on development in the northern portion of the Bay Area (even though the majority of growth would still be southern)
- New growth will be dispersed at a low density consistant with current trends and only a moderate level of environmental or development controls

Alternative Future Three-Moderate City-Centered--This future reflects a possible extensive regional effort to create and enforce strong development controls and to preserve open space and environmentally sensitive areas.

Figure S-8

COMPARISON OF ALTERNATIVE FUTURES FORECASTS
TO CALIFORNIA STATEWIDE TRANSPORTATION STUDY--1995

	1970	1995 Population Forecast Alternative Futures			1970	1995 Employment Forecast Alternative Futures		
	Baseline	#1	#2	#3	1970 Baseline	#1	#2	#3
CORRIDOP REGION	5,725.7	7,922.2	8,680.3	8,680.2	2,350.2	3,252.2	3,641.6	3,684.2
San Francisco Bay	4,630.7	6,393.0	7,058.1	7,058.1	1,927.3	2,607.7	2,957.9	3,000.5
Sacramento	803.6	1,132.1	1,203.6	1,203.6	307.4	472.6	502.5	502.5
Stockton	291.9	397.1	418.6	418.6	115.5	171.9	(181.2)	181.2
Counties								
Alameda	1,076.1	1,393.0	1,401.2	1,451.0	457.4	679.6	726.9	773.9
Contra Costa	558.1	891.4	937.4	923.8	137.2	204.1	309.1	310.0
Marin	207.5	287.8	351.4	320.0	50.7	64.5	98.4	79.0
Napa	79.7	145.7	227.4	170.7	25.8	32.2	52.7	36.4
Placer*	67.6	97.2	110.1	93.7	18.0	33.7	(38.2)	37.2
Sacramento	637.5	877.0	919.0	944.7	256.3	374.5	373.0	397.9
San Francisco	714.3	722.3	723.4	777.0	1,198.5	544.6	561.5	573.0
San Joaquin	290.7	30.1	(418.6)	418.6	115.5	171.9	181.2	181.2

*Roseville District Only

Figure S-8 (cont.)

COMPARISON OF ALTERNATIVE FUTURES FORECASTS
TO CALIFORNIA STATEWIDE TRANSPORTATION STUDY--1995

	1970	1995 Population Forecast Alternative Futures			1970	1995 Employment Forecast Alternative Futures		
	Baseline	#1	#2	#3	1970 Baseline	#1	#2	#3
San Mateo	556.7	746.9	700.7	776.0	216.3	291.7	268.1	306.2
Santa Clara	1,074.8	1,576.4	1,579.9	1,576.7	428.7	652.8	669.3	674.1
Solano	173.6	285.0	479.4	460.2	54.1	62.1	134.5	119.7
Sonoma	205.2	344.5	657.3	652.7	58.7	76.1	137.4	128.2
Yolo	92.0	157.9	174.5	165.0	33.1	64.4	71.3	67.4

- Assumes a moderate growth rate

- A new emphasis would be placed on development in the northern portion of the Bay Area (both of these points similar to Future Two).

- New growth will be city-centered, in all three areas of the region, occurring by infilling or as an orderly extension of existing development.

Focus--Regional Environmental Quality

Concern with the environment or quality of life is becoming an increasingly important factor in both public and private decisions. Transportation will impact on the environment in two ways. Directly in terms of land requirements as well as noise and air levels; indirectly in the manner in which land development processes respond to transportation decisions. Both of these aspects of potential environmental change are of prime concern to this study.

Physical/Environmental Analysis

A preliminary environmental analysis has been carried out at a generalized level for the Study Area. The purpose of this analysis is four-fold:

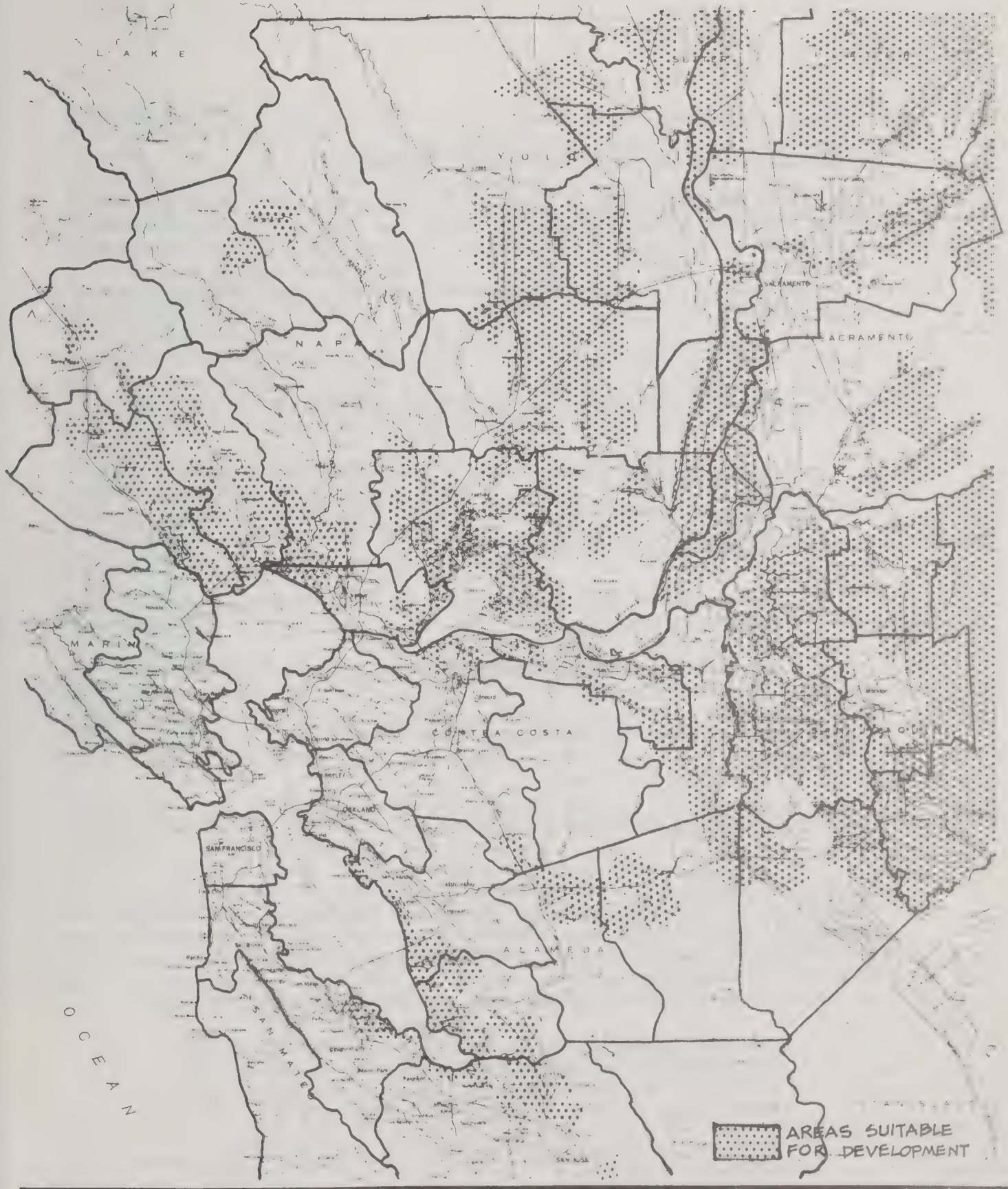
- to develop an understanding of the most significant constraints and suitabilities for location of interregional transportation facilities from the point of view of construction costs and impacts;

- to develop a composite of physical/environmental factors that will identify probable future growth areas--with or without transportation improvements (used as an input to alternative futures);

- to develop background information to judge the potential indirect environmental impacts of growth to which transport improvements may contribute;

- to evaluate environmental goals, policies and critical issues within the Study Area.

The results of this analysis are shown in figure S-9 indicating the areas in the region most suitable for development. At later stages in this study, the specific impacts resulting from the various transportation alternatives will be investigated.



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SACRAMENTO·STOCKTON·SAN FRANCISCO BAY AREA·CORRIDOR STUDY

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Environmental Evaluation of Alternative Futures

Alternative Future One--It is likely that this development will proceed with a low order of environmental controls, in areas which are generally suitable for development. Environmental impacts will be relatively low, but widespread. Degree of impact will be, to a large extent, a question of design quality. Within this framework, impacts of this alternative future will be:

- loss of prime agricultural land in San Jose area
- continued dependence upon personal automobile with high order of road and freeway construction
- relatively high material requirements for utility infrastructure
- expanding commute distances require more time and energy consumption (depletion of fossil fuel resources) and place greater demands on existing highways
- destruction of large areas of vegetation and wildlife habitats--though not critical ones
- modification and pollution of natural waterways; covering of acquifer recharge areas
- soil erosion (mostly during construction)
- sterilization of soil
- overuse of chemical pesticides (after habitation)

Alternative Future Two--It is likely that development controls will have to increase relative to the increases in numbers and densities. Generally growth will occur in the most suitable areas with the same kinds of impacts as Alternative Future One. But they will be more substantial because of increased densities and wider coverage. In addition, the shift of emphasis to the North Bay Cities will have have the following specific impacts:

- negative influence on the quality and character of valley centered riparian environments, the Bayside marshes at their outlets, and ultimately the water quality of the North Bay.
- loss of some prime wine producing lands in the Napa, Sonoma and Santa Rosa areas

Alternative Future Three--Surprisingly, under the moderate city-centered forecast more persons will live in suburbs than under the low dispersed concept, because of the general inability to accommodate added growth in the cities. This indicates that the most significant factor in reduced suburban growth--and resulting environmental preservation--will come from reduction in the birth rate and in-migration and not from city-centered or suburban protection policies.

In order for this alternative future to occur, there must be strict development controls to determine the location and nature of development. All development would go in suitable areas and with the envisioned controls, environmental impact would be lower than with the other alternative futures. Significant amounts of open space for recreation, agriculture and conservation would be preserved. In many respects this would be the most environmentally sound alternative.

Perhaps the most important impact of this alternative will be the high level of use that citizens of a dense city-centered region would inevitably place on the surrounding open space lands. The balance of these environmental impact considerations is complex and warrants a broader examination than is possible in this cycle.

Next Steps

During the next 6 to 7 months the preliminary investigations initiated during cycle I and reported here will be broadened to cover issues not yet investigated; for example, specific location studies, capital and operating costs. In addition, much more detailed analysis will be made on those items such as system patronage which has been briefly covered.

The key activity in Cycle II, to be completed within the next two months, is the formulation of total alternative multimodal transportation program packages for detailed testing. It is important that these alternatives represent the ideas and desires of a wide range of viewpoints.

The purpose of this report is to solicit these viewpoints. If you desire more information or wish to comment on any aspect of the issues, alternatives and finding contact one of the following at the address shown.

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PART ONE - FRAMEWORK FOR FORECASTING

II. DESCRIPTION AND HISTORY OF THE CORRIDOR REGION

The corridor region consists of thirteen counties located around the three central cities of Sacramento, Stockton, and San Francisco. The San Francisco Bay Area surrounds the largest and finest bay on the Pacific coast, and occupies coastal hills and valleys. Both the Sacramento and Stockton areas are located in the great flat Central Valley of California. To the east of this valley rises the Sierra Nevadas. The study area is shown in figure 1.

II.A. Physical Description - Bay Area[1]

There are nine counties surrounding the San Francisco Bay. Starting at the Golden Gate and proceeding clockwise, Marin, Sonoma, Napa and Solano comprise the North Bay counties. Contra Costa and Alameda counties are in the East Bay, and Santa Clara and San Mateo counties occupy most of the peninsula which separates the southern portion of the Bay from the Pacific Ocean. At the northern tip of the peninsula is the City and County of San Francisco.

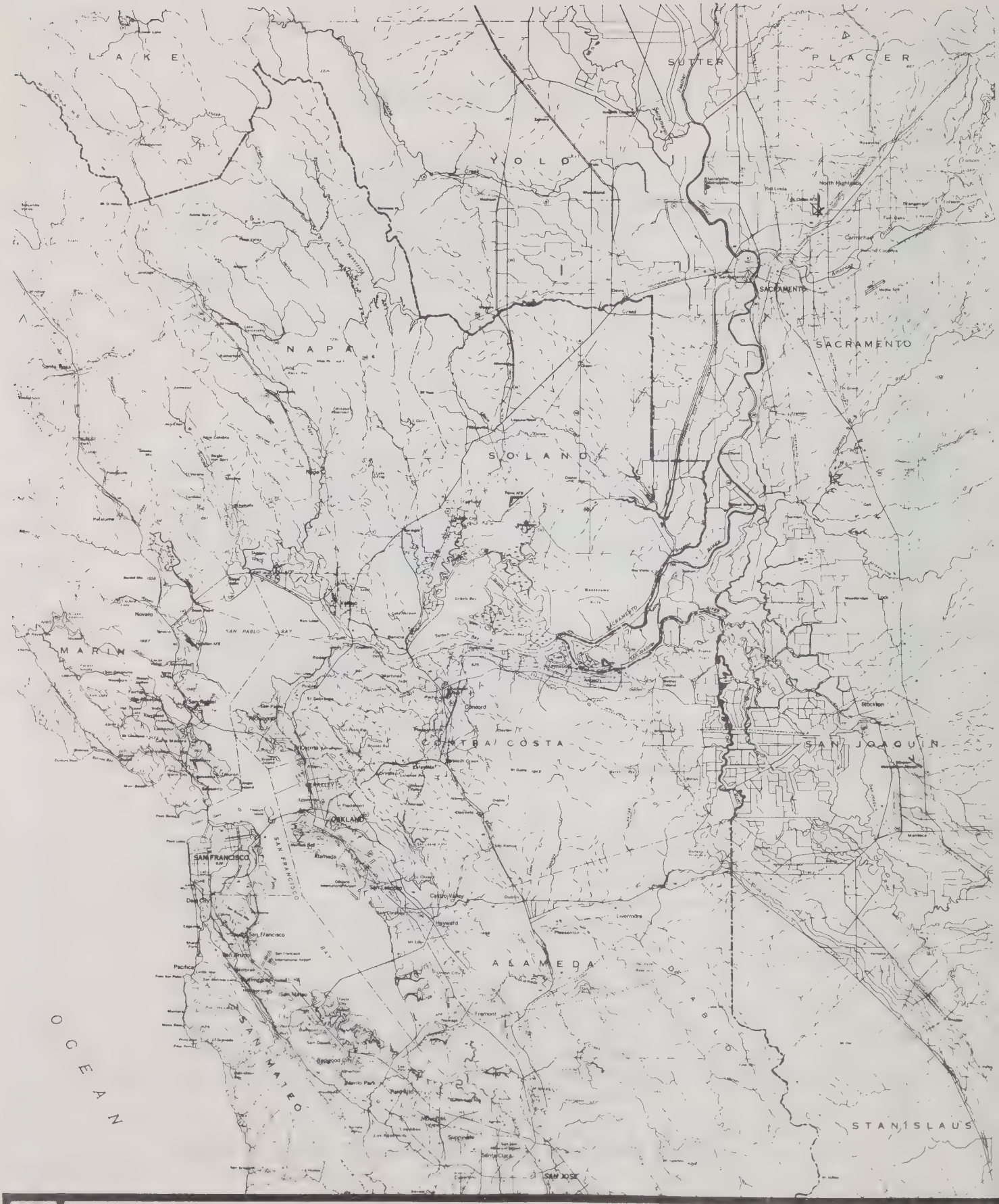
The Bay is the most distinctive geographical feature of the region, covering some 450 square miles, and ranging from 3 to 12 miles in width and up to 48 miles in length. Forming one of the world's outstanding harbors, the Bay provides a sharp contrast to its densely populated shores.

The periphery of the Bay is characterized by a band of flatlands and tidal marshlands (much of which has been filled), giving way to the coastal mountains which virtually ring the Bay.

In addition to the areas along the Bay shore, flat land is also found in the Santa Clara Valley and in the valleys of Alameda, Sonoma, Napa, and Solano counties. The pattern of urbanization has been greatly influenced by the topography. Extensive development has occurred in areas accessible to the Bay, and in areas in which site preparation is not unduly expensive. Thus, early development concentrated in San Francisco, Oakland and northern Alameda County and in the Santa Clara Valley.

The hilly terrain of eastern Contra Costa, Marin, and San Mateo's coastside provide an ideal suburban setting. Within minutes of the densely populated central cities, these areas project a small town, sometimes rural image. The cost of developing the steep hillsides has in many instances, allowed the preservation of substantial open spaces. Much of the

[1]This description draws heavily on work by the Security Pacific Bank.



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hilly areas have remained totally undeveloped, and most Bay Area residents are within a few minutes drive of these wooded open areas.

A tour of the counties reveals some striking differences within the relatively limited area. Marin County is a rugged peninsula with deep, wooded valleys. Marin's Pacific shoreline is dotted with numerous coves and bays, most prominent being Tomales Bay, Bolinas Lagoon and Drake's Bay. In Sonoma County, the valleys become less deep and considerably wider, making the land more productive for agriculture. Principal valleys include the Santa Rosa, Sonoma, Russian River and the Valley of the Moon. Napa County is similarly characterized by northwest to southeast mountain ranges and valleys, the major valley being that of the Napa River, which flows into the marshlands along San Pablo Bay. In Solano County, the mountains are considerably lower and less steep. In the southern part of the county are the Bay marshlands, and in the east, the level Sacramento River flood plain.

Along the eastern shore of the Bay, in Contra Costa and Alameda counties, lies an alluvial plain varying in width from 3 miles in the north to 12 miles in the south. The Berkeley and San Leandro hills lie beyond the plain, and east of the wooded hills is an extensive system of valleys opening into the delta and sedimentary lands of the Central Valley.

The dominant feature of Santa Clara is the broad, level Santa Clara Valley, located between the Santa Cruz Mountains and the Diablo Range. Formerly a rich agricultural area, much of the Valley is now urbanized. The Santa Cruz Mountains continue northward, forming the backbone of the peninsula occupied by San Mateo County. On the eastern side of the hills the flatlands are heavily populated. San Francisco is located on the hilly northern tip of the peninsula.

II.B. Sacramento Area

The three counties which make up the Sacramento metropolitan area extend all the way from the western edge of the Central Valley, some 50 miles northeast of San Francisco, over the Sierra to the Nevada state line. To the west Yolo County starts in the eastern edge of the coastal hills. The central portion of Yolo County is a rich agricultural plain built up by the Sacramento River. The dominant geographic landmark is the wide Yolo Bypass in east Yolo which serves a flood protection purpose for Sacramento. In between that bypass and the river itself, is river area which serves as the port, and as a bedroom community, of the City of Sacramento.

Sacramento was located at the confluence of the American River, flowing west from the Sierras, and the Sacramento River, the largest river in California, which flows south from the Mt. Shasta area into San Francisco

Bay. Much of Sacramento County, east and south of the urbanized area is rich, flat agricultural land. The southwestern portion of the county consists of numerous islands in the Sacramento-San Joaquin Delta. Placer County extends from the northern city limits of Sacramento across the Sierra to Lake Tahoe. The western portion which lies in the Sacramento Valley and extends (like Sacramento and San Joaquin Counties) easterly into this gently sloping foothills of the Sierra is of special concern to this study.

II.C. Stockton Area

The Stockton Area is comprised entirely of San Joaquin County which is bordered by Sacramento County on the north and Contra Costa and Alameda Counties on the west. Stockton developed as a river port--for agriculture, lumbering, and mining--on the San Joaquin River. This river drains the southern portion of the Central Valley of California, and flows into the Sacramento-San Joaquin Delta, where it mixes with the Sacramento River and both flow into San Francisco Bay.

The level of both the Sacramento and San Joaquin Rivers has diminished in recent years with extensive use of their waters for agricultural purposes within the Central Valley. A large portion of water which formerly drained into the San Joaquin is piped directly to the San Francisco metropolitan area. The California Water Plan sends a significant portion of Feather River water through the Sacramento River into the Delta, then pumps it out for transmission to the west side of the San Joaquin Valley for irrigation purposes and to Southern California for domestic use.

II.D. The Delta

The Delta is a triangular-shape formed by the confluence of the Sacramento and San Joaquin Rivers, with Stockton on the eastern edge and the eastern most point of San Francisco Bay (Suisun Bay) on the west. Though surrounded by the three major population centers of California the Delta contained in 1970, less than 15,000 persons. The Delta is one of Northern California's most active recreation areas, with boating (especially houseboating) and hunting extremely popular.

II.E. Corridor Travel History

Origins-- The original transportation corridor problem within this region arose in 1849 as passengers and sailors left sailing ships in San Francisco and attempted to find a way to Sacramento and the Gold Rush country of the Sierras. The rapid population expansion of this area was employment-based as men sought to make their fortunes by discovering all or a part of the

Mother Lode. The initial transportation problems were solved by taking steam boats up the Sacramento River, by taking stage coaches at outrageous prices or most frequently by walking. The three central cities of Sacramento, Stockton and San Francisco developed as commercial centers for the gold rush activity.

San Francisco was the major port and jumping-off place for the gold seekers and soon became the major trade, manufacturing, and financial center of the West. The Gold Rush actually got underway in the spring of 1849. San Francisco's population rose from approximately 1,000 in 1848 to 10,000 in 1849, doubled to 20,000 in 1850 and by January 1851 reached an estimated 35,000. For the times, and considering the difficulty of long distance travel, the rapidity and volume of the Gold Rush in-migration was extraordinary.

The subsequent settlement--originally to service gold rush development--and later in support of the ranching and agricultural activity were beginnings on which the present patterns of urbanization were built. The agricultural-gold-port axis represented by the Sierra Foothills/Central Valley/Bay Area was the scene of California's early development throughout the 19th century and movement of the capital from several earlier sites to Sacramento was in response to this fact. Today, Sacramento, as capital city, has important ties with the Bay Area as the financial, business and industrial center of Northern California, as well as with Stockton, an agricultural and business hub of the Central Valley.

The pattern of urbanization which developed in the late 19th and early 20th centuries responded not only to the location of critical natural resources (gold, land, water), but also the natural and man-made transportation infrastructure. The original trail from San Francisco to Sacramento has been paralleled by route 80. The rivers and tributary network also provided intracity mobility in the regions via steamboat. However, the construction of the transcontinental railroad segment between Oakland and Sacramento in 1869, and the subsequent interurban rail network linking the East Bay, Stockton, and Sacramento, gave substantial impetus to their growth.

Early Public Transit-- The turn-of-the-century interurban rail system of freight and commuter trains serving the Bay Area was the forerunner of the freeway and highway systems of today. The important cities grew up at rail heads and rail/water junctions serving as supply or transfer centers for the mining, farming, shipping, and governmental activities.

The first regular interurban public transportation in the region aside from the infrequent service offered on the Southern Pacific railroad from the late 19th century was the Sacramento Northern. This electric system ran a 183 mile line from Chico to San Francisco largely on

its own right of way. Starting in 1907 regular service ran between San Francisco to Sacramento, connecting with the Key System Ferries in Oakland through a tunnel into Walnut Creek and Lafayette. A six car ferry at West Pittsburg connected to the long straight run using a Yolo Basin trestle to Sacramento. At it's peak in the twenties this run was made in about two and one-half hours, seven times a day, despite the two ferry crossings.

The Sacramento Northern also ran service to Marysville, Chico, Dixon, Vacaville and Danville.

During the early twenties Southern Pacific railroad started more frequent service on their predominantly freight line and in 1930 built a bridge across the Carquinez Straits. This along with the growing use of the automobile and the depression cut into the financial viability of the Sacramento Northern service. Despite it's entrance into San Francisco over the Bay Bridge in 1939, regular intercity service was abandoned in 1940 and taken over by bus.

Sacramento to Stockton service was also run on two hour intervals between 1910 and 1933 and several other shorter lines operated in the North and South Bay areas into the thirties. Today the remnants of the interurban rail system are the Southern Pacific commuter trains operated on the peninsula and the scheduled intercity bus service offered by Greyhound, Trailways and others.

Begun by the interurban railways of the turn-of-the-century and spurred by the postwar population boom and automobility in Northern California, the patterns of suburbanization familiar today took shape.

The population of the study area is approaching 6 million. Urbanization has been rapid and widespread, and the study area is projected to experience a 50 percent population growth by 1995. The corridor will thus be facing a rapidly growing demand for transportation services as economic interdependence increases and as the population continues to express its wealth in growing mobility.

III. PHYSICAL/ENVIRONMENTAL ANALYSIS

A preliminary environmental analysis has been carried out at a generalized level for the Study Area. The purpose of this analysis is fourfold:

- o to develop an understanding of the most significant constraints and suitabilities for location of inter-regional transportation facilities from the point of view of construction costs and impacts.
- o to develop a composite of physical/environmental factors that will identify probable future growth areas--with or without transportation improvements (used as an input to alternative futures).
- o to develop background information to judge the potential indirect environmental impacts of growth to which transport improvements may contribute.
- o to evaluate environmental goals, policies and critical issues within the Study Area.

III.A. Suitability Analysis

The physical/environmental suitability analysis was carried on by recording and comparing available information on inherent geo-and biophysical facts. The first step was to map the following factors:

- o topography--at 500' intervals.
- o slopes--15-30% considered limiting to development, 30% considered undevelopable and subject to landslide and erosion hazards.
- o hydrology--open fresh and salt water, mud flats, marshes rivers, creeks, canals, salt evaporators, major watersheds.
- o erosion--in four degrees of erodibility.
- o vegetation--woods or brushwood, orchard (more specific data will be required).
- o wildlife--game refuges, important marshland and river habitats, migratory ranges, rare and endangered species ranges.
- o existing land-use commitments--urbanization, subdivision, State game reserves, parks, military lands.

- o major transportation elements--freeways, arterials, railroads, BART, commercial, military and general aviation airports.

- o hazards--faults, earthquake intensity zones, flood plans, landslide zones.

- o agricultural open space--irrigated farm land, dry farm land, grazing land, timber land.

- o recreation open space--parks, wildlife/game reserves, marshes and salt evaporators, open surface water or mud flats, land over 1000' above sea level, woodland and brush, peaks and ridges (more specific recreation data will be necessary).

- o wildlife and conservation open space--parks and wildlife/game reserves, areas with concentrated waterways, marshes or salt evaporators, open surface water or mud flats, areas of very severe soil erodibility, woodland or brushland, important marshland habitats, migrating deer winter range, salmon and steelhead habitats, range and endangered species ranges.

No attempt at this time was made to distinguish between the relative values of these factors. Few of the factors are absolute deterrents to development although individually they may influence the safety, economy, density, etc., of development.

Other factors which were not included in the Schematic Suitability Analysis, but which may be added as necessary in later phases on a more limited geographic basis are:

- o geology and soils (except hazard)

- o air quality

- o fog

- o significant historic, archeological or historic resources

- o aesthetic features

The second step was to review the factor maps and extract information with similar implications. These were combined in the following factor correlation maps:

- o Agricultual open space as Suitability for Agriculture--showing ranges in productivity. Prime agricultural land is increasingly experiencing development pressure since it coincides with areas that are suitable for development. In the light of stated goals and policies, this will require further examination in Phase II.

- Conservation/wildlife/open space as Suitability for Conservation/ Wildlife--these lands are extremely fragile and to a great extent are coincident with open lands suitable for development. This conflict highlights the need for close attention in Phase II.

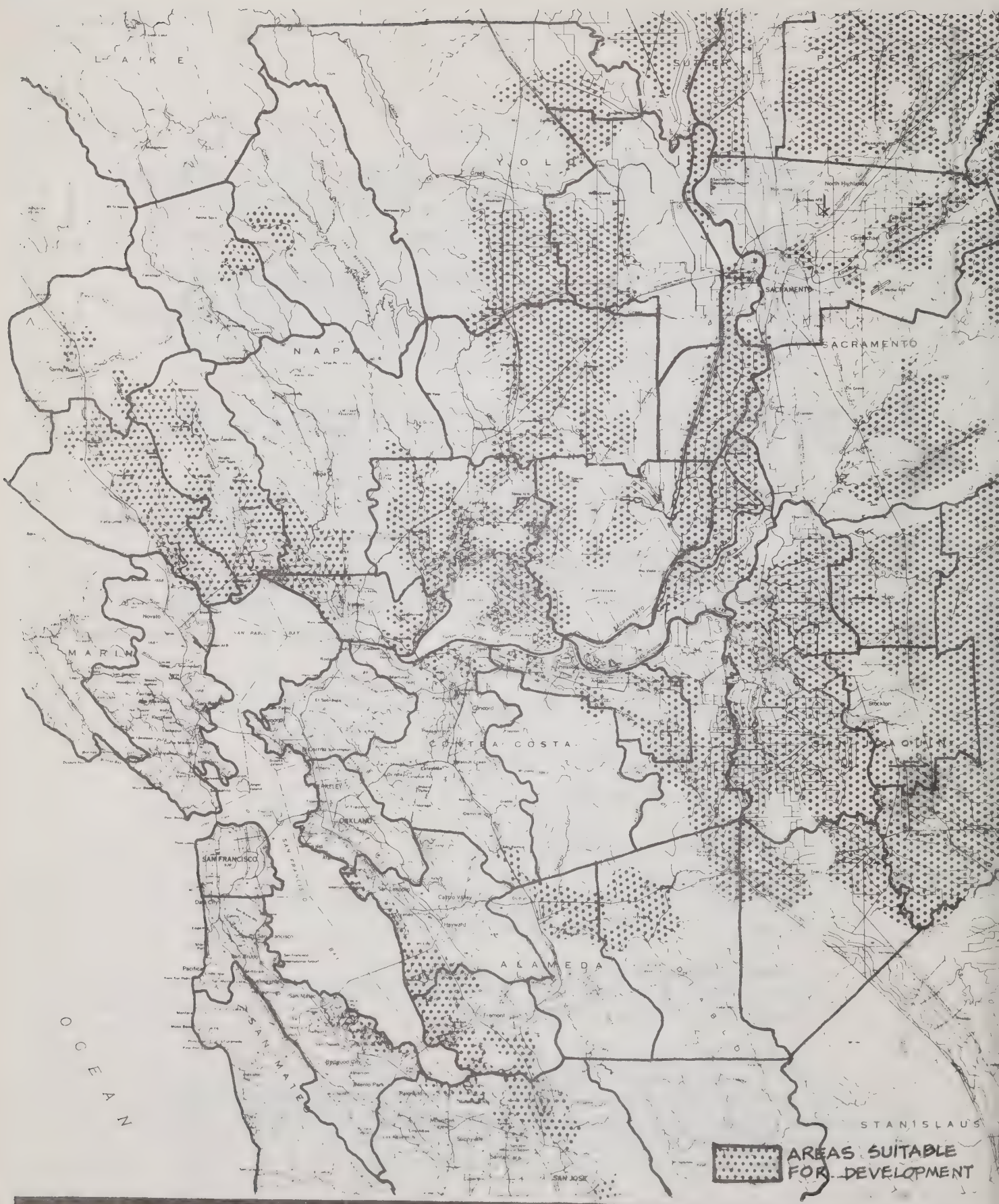
- Recreation/Open Space as Suitability for Recreation--these lands reflect aspirations as well as actualities since some of the land is currently in private ownership. Recreation-generated travel is of importance to this study and will require more detailed analysis in Phase II.

These maps, while they remain unweighted, carry an implied or intuitive value system. For example, irrigated farm land is assumedly more valuable and productive than dry farm land or grazing land.

The final step was to select and combine information from factor maps and factor correlation maps in order to produce a map entitled Suitability for Development. This map reveals those areas within the region offering opportunities for corridor location and urban growth with least impact on the physical environment. Development is considered unsuitable in areas where two or more factors coincide. The ten factors considered in this determination were:

- Existing urban areas and military lands
- Parks and wildlife/game reserves
- Land over 1000' above sea level
- Marshes and salt evaporators
- Open surface water and mud flats
- Faults and fault zones
- Flood plains and flood channels
- Zones in which some areas may flood
- Zones of most abundant landslides
- Soil erodibility very severe

Not shown are zones of intense earthquake shaking and prime agricultural lands which historically have acted only as partial constraints. This map is shown as figure 2.



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III.B. Suitability Analysis and Landscape Provinces

A generalized view of the environmental and physical characteristics of the region shows the presence of a number of distinct and unique landscape provinces (see figure 3).

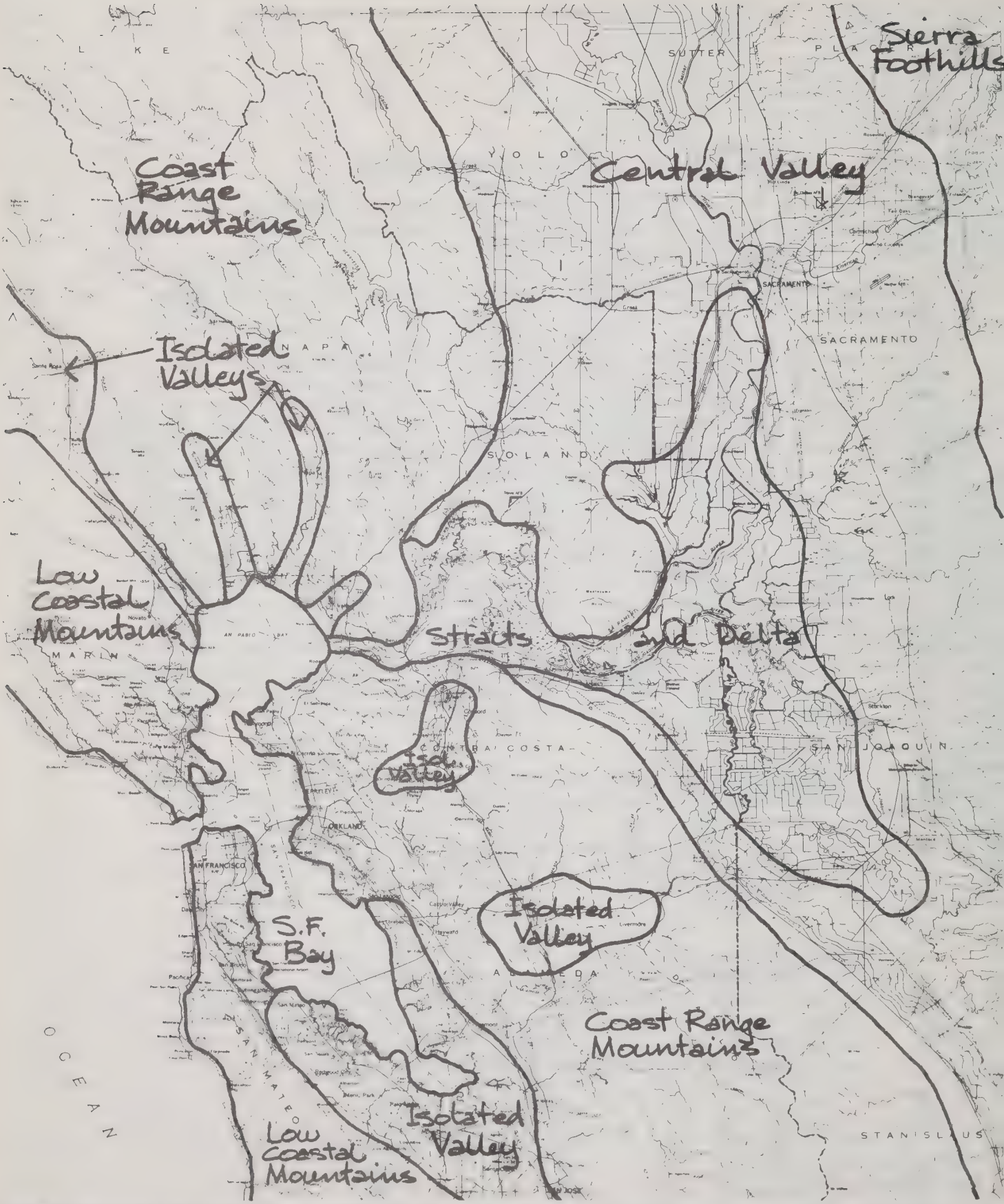
The diagrammatic section of figure 4 illustrates the location of these provinces.

The Coastal Strip -- is characterized by headlands, beaches, dunes, lagoons, estuaries, bays, salt marshes, islands, maritime flora and fauna and great scenic value. Expression of public interest in saving and protecting the environmental values of this strip was confirmed with the passage of the Coastal Initiative. While it is not central to the study area, this places severe limitation on development within the province.

Low Coastal Mountains -- are characterized by steep slopes, earthquake hazards, severe soil erodibility and lack of soil fertility. There is moderate to heavy vegetative cover--redwoods, eucalyptus, chaparral and grassland plus much ornamental planting. Part of the province, close to San Francisco is heavily urbanized. Farther from the urban center, the land is used for grazing. Present trends suggest that development might continue until the suitable areas are consumed by low density suburbanization.

The San Francisco Bay -- as a great visual, recreational and open space resource that serves as a limit to development, and commands the focus of the region. To a large extent it is edged with dense development. The remainder of the edge is characterized by salt marshes, salt evaporators, and mud flats. BCDC controls growth along the portions of the Bay edge.

The Coast Range Mountains -- are a series of parallel ranges and ridges oriented in a general north-south direction. They are steep, highly eroded, and subject to landslides. They are covered with brushwood, trees and grassland, and are used mainly for grazing purposes. Development is unlikely in these mountain areas because of the frequency of coincidence of physical constraints.



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REGIONAL LANDSCAPE PROVINCES

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4

REGIONAL LANDSCAPE PROVINCES

Diagramatic section

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The Isolated Valleys -- found within the framework of the Coast Range Mountains are characteristically flat, agricultural lands that have been converted to be the Walnut Creek/Concord and Livermore/Pleasanton Valleys. The undeveloped remnants of these valleys are under immediate pressure for suburban expansion. Improvements to access will hasten this process.

The Central Valley -- is the historic flood plain of the Sacramento and San Joaquin Rivers. Its fertile alluvial soils are intensively used for agriculture. It is characterized by a network of rivers, tributaries, distributory canals and sloughs. These are important sources of water for agriculture and industry, and contribute to the recreational quality of the region for boating, fishing, hunting, and picnicking. Salmon, steelhead and striped bass use the waters for spawning and nursery habitat. The mature rivers have associated marshes and tules which are important migratory water fowl habitats, and high in aesthetic value. Native vegetation such as bunch-grass associations and oak woodlands are rapidly disappearing resources. Sacramento and Stockton are the main urban areas within the great valley. Both cities in varying degrees are faced with the challenge of accommodating growth and expansion and are influenced by the magnetism of the Bay Area. Both of these issues are placing demands on prime agricultural lands.

Straits and Delta -- connect the central valley with the San Francisco Bay as a drainage corridor. As this province is walled in by steep topography edged with frequent marshes, development has been limited to a narrow strip of the flood plain. Areas between existing communities are subject to urban infill. The Straits and Delta present a major barrier to development and transportation. The environment of this province is extremely bulnerable.

The Sierra Foothill Region -- is typified in its lower reaches by rolling terrain ascending at a gentle slope toward the Sierra crest. The land is covered with grassland, Chaparral, Digger Pine and Blue Oak associations. It is dry country with fire hazard during the summer and autumn months. The areas is extensively used for grazing and to a lesser extent for mining. The province is crossed by a number of important scenic access routes to the high Sierra. There are a number of small communities in the foothill area. None of these are experiencing heavy pressures for growth. The trend toward the development of recreational second-home communities, however, is likely to continue.

III.C. Environmental Problems and Environmental Consciousness

Future development, whether encouraged or merely permitted by accessibility, will, in either case, have environmental impacts. Development historically has not always respected environmental values or physical contraints. This has led to several historic problems within the Study Area.

Seismic Activity--San Francisco is famous for the 1906 earthquake which, when followed by a major fire, resulted in the virtual destruction of the city. San Francisco is not the only area in the study region susceptible to major seismic activity, but at the time of the 1906 quake, it was by far the most urbanized.

The possibility of new or repeated seismic activity is always present although it defies accurate prediction. The major response to the potential seismic hazard has been the development of specific building standards. These standards are often the subject of controversial debate and the extent to which they are indeed earthquake proof will not be known until tested.

In addition to the potential of major disaster from significant seismic activity there is also the gradual, but continuous damage to the urban matrix resulting from creep or slippage along fault lines. The San Andreas and Hayward faults are by far the most significant from this standpoint.

Subsidence and Flooding— Due to the use of domestic water obtained from wells in the generalized South Bay Area there has been a major reduction in level of the water underlying that area. The reduction in water level in conjuction with increased surface loads resulting from urban development has produced a major areal subsidence which at one point was running as high as six inches a year. Since the conversion of domestic water supply to the Hetch Hetchy Reservoir and the impounding of water along major aquifer recharge areas further subsidence has been substantially halted. South Bay communities from Palo Alto, San Jose are left, however, with major flood potential problems.

Other instances of flooding are not uncommon and in very recent history the Greenbrae/Larkspur area and Isleton in the Delta area have experienced major damage from flooding. The typical response to these problems has been to form flood control districts who, in association with the U. S. Army Corps of Engineers, then proceed to design and construct flood control measures. The wisdom gained from these experiences is giving frequent emphasis to flood plain zoning and the exclusion of building from these areas. The problem is an expanding one, however, for urbanization within a watershed results in increased and more rapid run-off, which in turn, expands the potential flood zone.

Wildlife and Wetlands--The San Francisco Bay was once a great habitat for fish and shell fish, surrounded by tidal marshlands which produced seven times as much plant and animal life per acre than the highest producing agricultural lands. This abundant source of food supported a large wildlife population, particularly migrating wild fowl.

Estimates as to the loss of marshland to urban and salt pond use run as high as one-third of the original Bay Area. The problems of developing these lands from a stability and foundation standpoint are extensive. More recently public objection to this type of land conversion resulted in the formation of the Bay Conservation and Development Commission and the substantial control of any additional filling of the Bay.

Steep Slopes, Soil Erosion and Landslides--The records of landslide problems are frequent. Most recently the heavy rains of the 1972-73 winter resulted in numerous slides in Marin County. These slides result in substantial public and private costs where development has occurred in these unstable areas. The typical response is to obtain designation as a disaster area and thereby gain access to loans with minimal financing charges. The wisdom of this after the fact solution versus more careful direction of urban growth warrants careful consideration.

III.D. Changes in Values--Environmental Objectives

The last few years represent an explosive increase in the process of expanding environmental consciousness. The causes of this increasing consciousness can be related to trends of high population growth, development, increased standards of living, consumption of energy and the depletion of resources. These trends may or may not as yet have resulted in the degradation of environmental quality, but they raise such a distinct and predictable consequence. Consideration has resulted and has occurred at the following conceptual levels.

- Personal - birth control; anti-litter consciousness, recyling of solid waste; use of biodegradable products; reduction in consummership, etc.

- Group - conservation/open space battles (Sierra Club, Friends of Mammoth, etc); group legal actions; boycotts, citizen participation in land use planning activities; etc.

- Professional - environmental impact evaluation; land capability analysis; public testimony; earth science research, etc.

- Institutional - ecology education in schools; planning; adoption of public goals, objectives, policies and laws relating to land use, development and environmental quality; air and water pollution controls, etc.

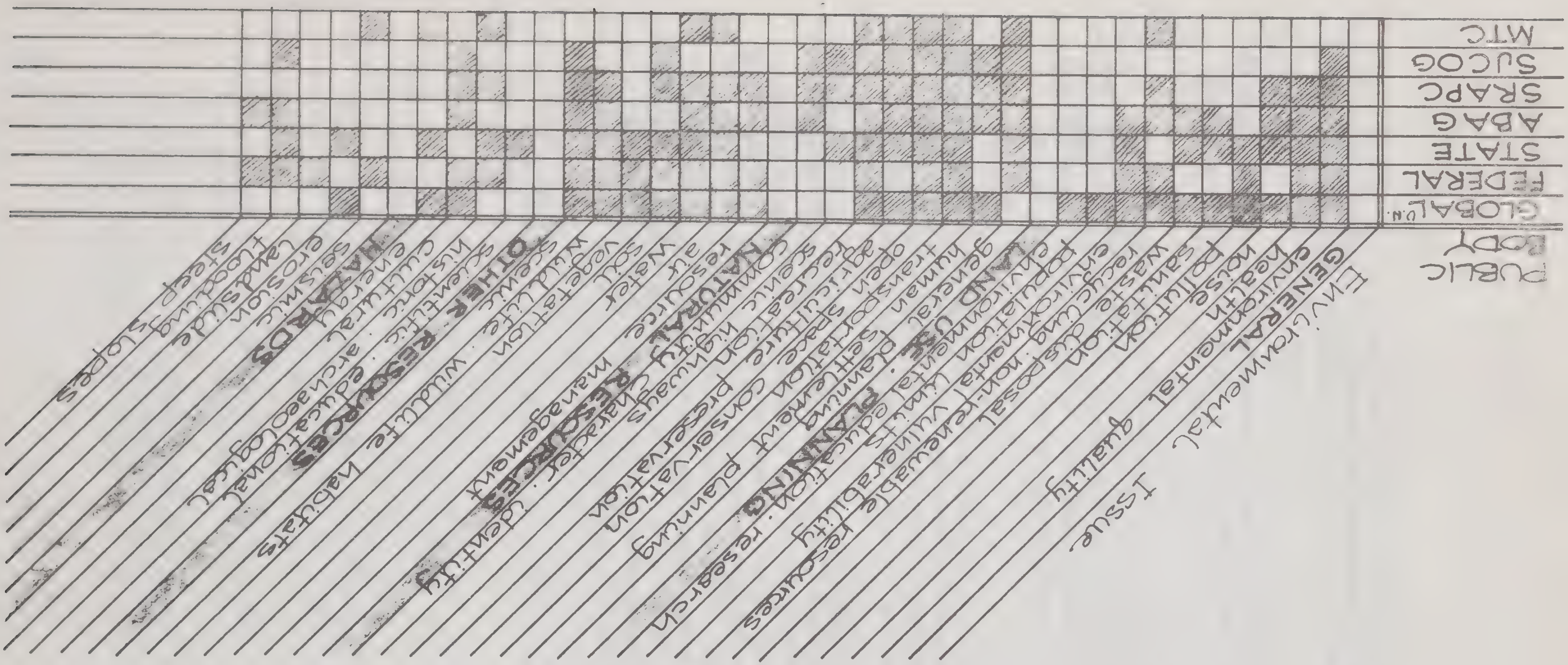
- Global - United Nations Stockholm Conference on the Human Environment (1972) Statement of "One Earth" environmental principles stressing the interrelatedness of planetary eco-systems.

This cursory list simply demonstrates an overwhelming concern for environmental issues and impacts that promises to exert itself with increasing forcefulness.

Most relevant to this study is the expression of concern by various public authorities of environmental goals, objectives, policies and laws. It is these statements that give definitive direction about the kinds of strengths of environmental concerns within the study area. They influence development suitability by establishing value or priority to various environmental issues.

The changes in vlaues recognized in the goals are policies of governments in the region in comination with the historical experience with the problems and missed opportunities in development which often ignored environmental values may bring a chnage in development patterns.

The Environmental Statement Matrix in figure 5 summarizes in a general way, stated environmental concerns by various public bodies. It is important to note that concern about the environment is being expressed from the global to the local levels. There are gaps on the matrix. This does not mean that the listed public agency has no interest in the appropriate environmental issue. It means that either no public statement has been made so far or that if the statement has been made,, research through this schematic cycle has not found it. At later stages in this study, in conjunction with specific improvement options, impacts on specific objectives in specific areas will be investigated.



SSBACS	SACRAMENTO·STOCKTON·SAN FRANCISCO BAY AREA·CORRIDOR STUDY		5
	ENVIROMENTAL STATEMENT MATRIX	AMV	
		DRA	
		EDAW	-27
	Stated Goals, Objectives, Policies, Laws	KE	

IV. SOCIO/ECONOMIC ANALYSIS

People and economic activity are the main generators of travel. The following section traces the historic population and employment trends of the Study Region.

This discussion is followed by the development of alternative projections of the aggregate and distributed population and employment in the region--based on economic, environmental and policy-related issues. These alternative distributions will be used both as a basis of travel projections and impact analysis in the evaluation of alternative transportation improvement programs.

IV.A. Population Trends--Study Region

Since the discovery of gold in 1848, the growth of California has consistently exceeded the national averages. Whether gold, orange groves, movies, or aero-space the economic potentials of the State have continued to attract a large number of people from other states in the Union. Until approximately five years ago, net migration exceeded natural increase as a component of change in the California population.

Within the State of California the earlier migration was to the Northern California area, with migration since 1900 concentrating on Southern California. In 1860 the Corridor Area had 43% of the State's population, with an almost equal amount located in the mountain counties of the gold mining activity. By 1880, there had been some decline in the mountain counties, and the Corridor Area had grown to nearly 60% of the State's population. Nearly half of the State's population was located in the San Francisco Bay Area, and one-fourth within the City of San Francisco. From that high point, the regional population, as a percentage of California, has declined to slightly below 30% in 1970. The San Francisco Bay Area has 1/2 of the share it had in 1880 and both Sacramento and San Joaquin areas are below their high points in 1880. Within the past few years, however, the migration into California has been more dispersed, with Northern California receiving the same share of new residents as its share of population. For both the San Francisco Bay Area and Sacramento the 1970 share of population is the same as that in 1960. These regional and county populations as a percentage of California are shown in figure 6.

Prior to 1960, most of the Bay Area's population growth occurred in the central Bay Area--San Francisco and Oakland and the surrounding suburban areas. These two central cities remain important employment centers, but both have experienced slight population declines between the 1960 and 1970 Censuses. For San Francisco, which prior to 1960 had the largest population among the nine counties, 1970 was the second consecutive Census

Figure 6

REGIONAL AND COUNTY POPULATION AS
PERCENTAGE OF CALIFORNIA 1860 - 1970

	1860	1880	1900	1920	1940	1950	1960	1970
Corridor Area	43.6	58.7	51.8	40.5	30.3	30.1	28.8	28.7
San Francisco Bay Area	30.0	48.8	44.3	34.5	25.1	25.3	23.2	23.2
Sacramento Area	11.1	7.1	5.1	3.7	3.3	2.9	4.0	4.0
San Joaquin	2.5	2.8	2.4	2.3	1.9	1.9	1.6	1.5
Counties								
Alameda (1)	2.4	7.3	8.8	10.0	7.4	7.0	5.8	5.4
Contra Costa (1)	1.4	1.4	1.2	1.6	1.5	2.8	2.6	2.8
Marin (1)	0.9	1.3	1.1	0.8	0.7	0.8	0.9	1.0
Napa (1)	1.5	1.5	1.1	0.6	0.4	0.4	0.4	0.4
Placer (2)	3.5	1.7	1.1	0.5	0.4	0.4	0.4	0.4
Sacramento (2)	6.4	4.0	3.1	2.2	2.5	2.1	3.2	3.2
San Francisco (1)	14.9	27.1	23.1	14.8	9.2	7.3	4.5	3.4
San Joaquin (3)	2.5	2.8	2.4	2.3	1.9	1.9	1.6	1.5
San Mateo (1)	0.8	1.0	0.8	1.1	1.6	2.2	2.8	2.8
Santa Clara (1)	3.1	4.1	4.1	2.9	2.5	2.7	4.1	5.3
Solano (1)	1.9	2.1	1.6	1.2	0.7	1.0	0.9	0.9
Sonoma (1)	2.1	3.0	2.6	1.5	1.0	1.0	0.9	1.0
Yolo (2)	1.2	1.4	0.9	0.5	0.4	0.4	0.4	0.5

Source: U. S. Bureau of the Census

which showed a population decline. The suburbs of Marin and Contra Costa counties have more than made up for the population losses of the central cities. Marin's population increased by over 40 percent to 206,038, while Contra Costa County's population was up 36.5 percent to 553,389. In Contra Costa County, the cities of Concord, Pinole and Walnut Creek more than doubled their populations during the last 10 years.

The major Bay Area growth during the last 20 years, however, has been concentrated in the South Bay--southern Alameda and Santa Clara counties. Of the fifteen Bay Area cities in which population more than doubled during the last decade, ten were in either southern Alameda or Santa Clara counties. This area accounted for approximately 60 percent of the Bay Area population increase since the 1960 Census. The South Bay's growth is centered in San Jose, where the population increased from 204,196 in 1960 to 445,779 in 1970. San Jose is now the second largest Bay Area city.

Elsewhere in the region, San Mateo County's population grew by more than 25 percent during the decade. Most of the land along San Mateo's bay-shore has been developed, and much of the current growth is concentrated in the hills and along the Pacific Coast. Daly City, Pacifica and Half Moon Bay are among the faster growing cities in San Mateo County.

In the North Bay, Sonoma County experienced a 39 percent population rise with Santa Rosa's population growing by 61 percent to 50,006. Solano County population rose by 26 percent during the decade, and the populations of two cities, Fairfield and Vacaville, doubled. Napa County population was up by 20 percent over the decade.

Sacramento retained its dominant position in the Sacramento metropolitan area becasue it could do what San Francisco and Oakland could not do--annex the new suburban growth. Sacramento County has grown sharply both in percentage and in absolute numers. The smaller and more rural counties of Marin, Napa, Placer, Solano, Sonoma, and Yolo have either declined or remained stable as a percentage of California population over the past century. The population of the region and counties since 1940 is shown in figure 7.

IV.B. Population Forecasts

The population forecasts made in this report are based on the most recent material of the State of California and the three councils of government (COGS) within the Corridor Region. The population research unit of the State Department of Finance makes statewide and county forecasts which have been used by the Association of Bay Area Governments and by the California Statewide Transportation Study.[1] The Sacramento Regional Area Planning Commission and the San Joaquin Council of Governments have made

[1] 1966 Base Year Calibration Report, May 1972

Figure 7

CORRIDOR REGION POPULATION HISTORY
(in Thousands of Persons)

Corridor Region	1940	1950	1960	1970	Increase 1960-70 Number	Increase 1960-70 Percentage
	2,094.2	3,241.5	4,514.4	5,725.7	1,211.3	26.8%
San Francisco Bay Area	1,734.3	2,681.3	3,638.7	4,630.2	991.3	27.2
Sacramento Area	225.7	359.4	625.5	803.6	178.1	28.5
Stockton Area	134.2	200.8	250.0	291.9	41.9	16.8
Counties						
Alameda	513.0	740.3	908.2	1,073.2	165.0	18.2
Contra Costa	100.4	299.0	409.0	555.8	146.8	35.9
Marin	52.9	85.6	146.8	206.8	60.0	40.9
Napa	28.5	46.6	65.7	79.1	13.2	20.0
Placer	28.1	41.6	57.0	77.6	20.6	36.1
Sacramento	170.3	277.1	502.8	634.2	131.4	26.1
San Francisco	634.5	775.4	740.3	715.7	(24.6)	(3.3)
San Joaquin	134.2	202.8	250.0	291.1	41.1	16.8
San Mateo	111.8	235.7	444.4	556.6	112.2	25.2
Santa Clara	174.9	290.5	642.3	1,066.9	424.6	66.1
Solano	47.1	104.8	134.6	172.0	37.4	27.8
Sonoma	69.1	103.4	147.4	204.9	57.5	39.0
Yolo	27.2	40.6	65.7	91.8	26.1	39.7

Source: Bureau of the Census

their own forecasts of population.

The population forecasts of the Department of Finance are based upon a demographic, "Cohort-Component" model. The demographic model underlying these projections employs assumptions concerning the components of population change--births, deaths and migration--and applies these to cohorts--groups of males and females born in specified years.

It is customary to introduce the specific assumptions underlying projections with a general statement to the effect that no war or catastrophy of sufficient magnitude to affect the basic conditions of life will take place. All current forecasts of the State and regions assume that California will experience no significant change in mortality by age during the next thirty years. The State Department of Finance current official forecast of population, prepared in September 1971, assumes that births will reflect the D level described by the Bureau of Census, a level which results in a completed fertility of 2.45 births per woman during her lifetime. The State has also prepared population forecasts which, while not official, assume that births will reflect the E level described by the Bureau of the Census, which results in a completed fertility of 2.11 births per woman during her lifetime. The latter is approximately that number required for the eventual attainment of zero population growth. While the birth rate for the past year or two has been closer to the 2.11 than the 2.45 level, the State believes that the rate will again rise, reflecting the evermore favorable (for childbirth) age composition of the population. The State believes that the recent lower birth rate was doubtless due to two factors, liberation of abortion laws and unfavorable economic conditions, which should have only a temporary impact. In upcoming revisions of the population forecasts the State will likely use a birth rate only slightly lower than that produced by series D of the census (or approximately 2.40 births per woman during her lifetime). If the conditions leading to the recent lower birth rate are not temporary, but are rather a response to a changed life style calling for fewer children, zero population growth and a desire for more freedom for women, then the series E forecast of the State is more likely to be valid. The Association of Bay Area Governments (ABAG) uses for their low estimate a birth rate between the series D and series E forecasts of the State and at approximately 2.24 per woman.

For comparison purposes this report includes for counties only, the State series C forecast which assumes a 2.87 birth rate per woman during her lifetime. These assumptions were used by the State and many counties for forecasts and plans made during the 1950's and early 1960's.

California's recent migration trend is most difficult to project into the future. From a high of 388,000 in 1957 the level has demonstrated a nearly steady decline to a low of only 24,000 in 1971. The State estimates net migration for 1972 at 40,000 and 1973 at 55,000. The

assumption was made in the official State forecast that an annual expected level of 150,000 would be maintained beginning in 1979-80 after a more steep and initial rise to 100,000 in 1974 and 1975. The State series D forecast, then, assumes 150,000 more arrivals than departures each year. The State series E is based on an assumption of zero net migration into the State while the State's series C assumes the 300,000 annual level which was common between 1953 and 1965.

The cohort component method of population projection represents civilian population only. State estimates are based in all series on a continuation of the current rate of approximately 300,000 military population within the State.

The result of the State forecast is a population of 8,706,700 for the Corridor by the year 1995.[1] This same number is used by the Transportation Study. The State forecast of 7,058,100 in the San Francisco Bay Area by 1995 is essentially that used by ABAG in its most recent projections of population growth. The Sacramento Area projections of the SRAPC are within 10,000 of those developed by the State, while that developed by San Joaquin County is within a few percentage points of the State's forecast. We conclude, therefore, that there is a general consensus on the total regional population by the State and the three regional bodies within the Corridor. We have included these forecasts in Figures 8 through 11 showing the Corridor and County forecast for 1980, 1990, 1995 and 2000. For comparison purposes, the results of the State forecasts under both series C and series E and the ABAG low forecast which lies between series D and series E are included.

IV.C. Employment

Population will be attracted to, and supported by, new employment in the Study Region. The three areas within the region--Bay Area, Sacramento and Stockton--have had differing patterns of employment in the past and will therefore show differing growth patterns in the future. The San Francisco Bay Area has been distinctive as the financial center of the western United States, as a major port and air cargo center, as a heavy industrial-petrochemical area and as the best-known center of new technology applications. Sacramento has developed as the State Capital and as a trade center for agriculture. Stockton has been an agriculture and food processing center for the San Joaquin Valley.

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[1]The District allocations developed in Figure 15 totals less than this forecast as only the Roseville district of Placer County is considered there. Figures 8 through 11 include all of Placer County.

Figure 8

POPULATION FORECASTS - 1980

	Prime Forecasts			Comparison Forecasts			
	State Series D	ABAG Baseline +	SRAPC SJC	State Series C	State Series E	ABAG Gen. Plan	County Estimates
CORRIDOR TOTAL	6,776.5	-	-	6,966.2	6,461.7	-	-
San Francisco Bay Area	5,481.9	5,481.9	-	5,641.4	5,197.7	6,150.8	5,549.7
Sacramento Area	954.5	-	971.5	976.5	932.1	-	-
Stockton Area	340.1	-	334.5	348.3	331.9	-	334.5
Counties							
Alameda	1,217.7	1,231.5	-	1,250.6	1,148.7	1,420.3	1,263.0
Contra Costa	689.1	744.0	-	706.0	650.8	821.8	689.1
Marin	261.9	240.6	-	272.2	242.3	307.6	248.0
Napa	102.5	110.7	-	108.0	96.4	103.7	103.7
Placer	95.0	-	103.7	98.8	90.9	-	-
Sacramento	740.5	-	749.4	752.9	728.3	-	760.4
San Francisco	721.6	718.4	-	735.5	712.3	806.7	710.0
San Joaquin	340.1	-	334.5	348.3	331.9	-	334.5
San Mateo	613.1	666.2	-	632.4	571.5	737.6	612.8
Santa Clara	1,386.6	1,307.0	-	1,425.4	1,306.6	1,435.5	1,386.0
Solano	214.3	211.7	-	222.8	211.9	236.7	262.0
Sonoma	275.1	252.2	-	288.5	257.2	280.9	275.1
Yolo	119.0	-	118.4	124.8	112.9	-	-

Sources: Association of Bay Area Governments
State Department of Finance, Population Research Unit
Sacramento Regional Area Planning Commission
San Joaquin County

Figure 9

POPULATION FORECASTS - 1990

	Prime Forecasts				Comparison Forecasts			
	State Series D	ABAG Baseline	ABAG Northern Tilt	SRAPC	State Series C	State Series E	ABAG Gen Plan	ABAG Low
CORRIDOR TOTAL	8,095.1	-	-	-	8,871.8	7,201.8	-	-
San Francisco Bay Area	6,556.8	6,556.9	6,556.7	-	7,183.3	5,773.1	7,477.1	6,108.5
Sacramento Area	1,144.8	-	-	1,153.6	1,266.7	1,060.4	-	-
Stockton Area	393.5	-	-	-	421.8	368.3	-	-
Counties								
Alameda	1,380.2	1,365.4	1,360.6	-	1,493.6	1,221.6	1,680.6	1,353.1
Contra Costa	852.4	901.7	867.4	-	942.9	733.7	1,080.0	850.7
Marin	335.9	350.2	331.0	-	365.2	285.7	408.7	276.0
Napa	147.3	188.9	202.2	-	170.0	113.5	139.8	133.2
Placer	123.9	-	-	130.2	142.1	105.8	-	-
Sacramento	865.3	-	-	868.9	944.2	817.9	-	-
San Francisco	730.0	721.8	721.8	-	772.9	706.4	826.6	721.1
San Joaquin	393.5	-	-	-	421.8	368.3	-	-
San Mateo	677.1	816.6	754.5	-	744.4	582.5	872.5	730.7
Santa Clara	1,760.3	1,419.7	1,438.3	-	1,918.6	1,561.0	1,784.7	1,483.3
Solano	303.1	298.5	298.6	-	340.2	261.5	315.8	243.2
Sonoma	370.5	494.1	582.4	-	435.5	307.9	368.4	317.2
Yolo	155.6	-	-	154.5	180.4	136.7	-	-

Sources: Association of Bay Area Governments
State Department of Finance, Population Research Unit
Sacramento Regional Area Planning Commission
San Joaquin County

Figure 10

POPULATION FORECASTS - 1995

	Prime Forecasts				Comparison Forecasts			
	State Series D	ABAG Baseline *	ABAG Northern Tilt *	SJC	Calif. State Traffic Study	State Series C	State Series E	ABAG Low *
CORRIDOR TOTAL	8,706.7	-	-		8,706.7	9,831.6	7,496.8	-
San Francisco Bay Area	7,058.1	7,051.5	7,051.4	-	7,058.1	7,955.5	6,000.3	6,393.0
Sacramento Area	1,231.0	-	-		1,231.0	1,414.0	1,112.1	-
Stockton Area	418.6	-	-	-	418.6	462.1	384.4	-
Counties								
Alameda	1,447.9	1,420.2	1,416.2	-	1,447.9	1,608.9	1,248.6	1,393.0
Contra Costa	923.8	963.9	922.4	-	923.8	1,046.4	765.1	891.4
Marin	370.2	369.4	351.4	-	370.2	409.9	303.8	287.8
Napa	170.7	212.7	227.4	-	170.7	204.7	120.8	145.7
Placer	137.5	-	-	-	137.5	165.3	111.8	-
Sacramento	919.0	-	-	-	919.0	1,037.9	852.2	-
San Francisco	727.0	723.4	723.4	-	727.0	790.3	698.3	722.3
San Joaquin	415.6	-	-	400.0	417.6	462.1	384.4	-
San Mateo	700.7	862.3	770.1	-	700.7	797.5	579.8	746.9
Santa Clara	1,933.5	1,582.0	1,579.9	-	1,933.5	2,157.2	1,669.0	1,576.4
Solano	357.6	401.2	403.4	-	357.9	420.6	283.0	285.0
Sonoma	426.7	552.4	657.3	-	426.7	520.6	331.9	344.5
Yolo	174.5	-	-	-	174.5	210.8	148.1	-

*Interpolated from 1990 and 2000 forecasts by Development Research Associates

Sources: Association of Bay Area Governments
Statement Department of Finance, Population Research Unit
San Joaquin County
California Statewide Traffic Study
Development Research Associates

Figure 11

POPULATION FORECASTS - 2000

	Prime Forecasts			Comparison Forecasts			
	State Series D	ABAG Baseline	ABAG Northern Tilt	State Series C	State Series E	ABAG Low	County Estimates
CORRIDOR TOTAL	9,309.4	-	-	10,856.0	7,765.3	-	-
San Francisco Bay Area	7,545.9	7,546.1	7,546.1	8,775.0	6,205.0	6,677.6	-
Sacramento Area	1,317.3	-	-	1,572.7	1,160.1	-	-
Stockton Area	446.2	-	-	508.3	400.2	-	-
Counties							
Alameda	1,510.7	1,475.1	1,471.7	1,729.2	1,273.2	1,433.0	-
Contra Costa	988.7	1,026.1	977.5	1,145.2	792.0	932.1	988.7
Marin	403.3	388.5	371.8	455.3	321.8	299.5	-
Napa	192.5	236.5	252.7	243.1	126.6	158.2	186.0
Placer	151.4	-	-	190.7	117.3	-	-
Sacramento	971.7	-	-	1,137.1	882.8	-	1,004.0
San Francisco	726.3	724.9	724.9	810.9	688.7	723.5	719.1
San Joaquin	446.2	-	-	508.3	400.2	-	-
San Mateo	719.4	836.0	785.7	853.4	574.2	763.1	-
Santa Clara	2,103.1	1,744.4	1,721.5	2,402.6	1,767.8	1,669.6	-
Solano	420.8	504.0	508.2	517.3	304.6	326.9	489.0
Sonoma	481.1	610.6	732.2	618.0	356.1	371.8	481.1
Yolo	194.2	-	-	244.9	160.0	-	-

Sources: Association of Bay Area Governments
State Department of Finance, Population Research Unit

These major roles are projected to continue in the future. Significant employment location shifts will occur within the San Francisco Bay Area, but not among the Study Region's three major areas. The San Francisco Bay Area has been, and will be dependent on state growth factors, while both Sacramento and Stockton will be supported by a resource-based industry--agriculture.

Within this section, a general description of employment patterns and trends is developed for each area and detailed projections provided by employment category by county. The source of these projections are the respective councils of government (ABAG, SRAPC, SJCOG). In each area and county only one projection is made based on and related to the official State population forecast, described in the above section as Series D. These are shown in figure 12.

Despite differences in basic employment, all study region areas will share in the growing national emphasis on population-serving employment. In the past, regions have typically assumed 50% basic employment and 50% population serving. Through 1995, however, 60% of new employment will be population-serving and only 40% in basic employment.

IV.D. Employment Distribution

A county-by-county discussion of employment distribution has been prepared as Appendix A. Below are summarized the major employment characteristics for the three metropolitan areas in the Study Region and the Delta.

IV.E. Bay Area Summary

Bay Area employment grew by 42.6 percent between 1960 and 1970, much faster than the U.S. but slower than California as a whole. Services, government, trade, and manufacturing were responsible for almost 84 percent of all Area employment gains. Within the Bay Area more than 71 percent of all employment was concentrated in western Alameda, San Francisco, and northern Santa Clara Counties in 1965. Employment concentrations have remained in these areas through 1970 with these three areas accounting for 65 percent of regional employment in 1970.

The Bay Area economy has been largely dependent on national growth factors over the past decade, dominated by industries that experienced rapid growth nationally.

Advantages of Bay Area location as expressed by Bay Area firms include: proximity to markets, transportation access, space for expansion, reasonably priced land, high quality labor. Disadvantages in some areas of the region are lack of space or reasonably priced land for expansion, high wage rates, lack of access, high taxes.

Figure 12

1970 EMPLOYMENT BASELINE

Corridor Region	5,725.7
San Francisco Bay Area	4,630.2
Sacramento Area	803.6
Stockton Area	791.7
Counties	
Alameda	1,076.1
Contra Costa	558.1
Marin	207.5
Napa	79.7
Placer	62.6
Sacramento	637.5
San Francisco	714.3
San Joaquin	290.7
San Mateo	556.7
Santa Clara	1,074.8
Solano	173.6
Sonoma	205.2
Yolo	192.0

The Bay Area overall is projected to increase at a rate much slower than that of the 1960's. An increase in the importance of population serving employment relative to basic employment is projected. Services will be the most important single factor in the region's economic growth. Population-oriented services is projected to be the largest employment category by 1995, accounting for 15 percent of the region's total employment. Basic services will be the third largest category with 11 percent of the region's employment.

New technology, including ordnance, electrical equipment, and instruments will be the second largest growth industry in basic employment. Other industries with relatively high projected growth rates are local government, metal fabrication and machinery, construction and retail trade. The growth and distributional characteristics of these major employment catagories are summarized below:

- Population-serving industries will be the greatest growth area, representing over 60 percent of total regional employment growth over the next 25 years. These industries will be distributed throughout the region with the population growth. Thus, those areas with attractive living conditions will also attract a good percentage of the region's new employment.

- Institutional service employement, including miscellaneous business services, educational services, museums, and miscellaneous services will acount for the largest increment in basic employment in the region between 1970 and 1995, representing about 40 percent of new basic employment and 15 percent of total new employment.

- Most counties will grow at approximately the same rate as the region in this area except San Francisco (with a larger 1970 base) which will grow at a slower rate and Napa and Solano will show very little growth in this category. Because of San Francisco's large base in this industry, it will still receive almost 12 percent of the new jobs in institutional services.

- New technology will account for about 21 percent of new basic employment in the region. Over half of this new employment is expected to occur in Santa Clara County, already a center for this type of industry. Alameda and San Mateo Counties will receive the majority of the rest of the growth in these industries and are also growing from a significant base.

- San Francisco will continue to decline in new technology employment, and the northern counties (Napa, Solano, Sonoma) are not expected to have much activity in this area.

- Metal fabrication and machinery should account for about 14 percent of new basic employment. Alameda and Santa Clara already have large employment bases in these industries and will account for 80 percent of new employment in metal fabrication and machinery. Contra Costa County should absorb about 14 percent of the new jobs. San Francisco will decline in this industry because of lack of available land. Sonoma and San Mateo Counties will absorb most of the remaining new growth.

- Federal and State government employment, not including military personnel and state college and university employees, will grow at about the same rate in all parts of the region. Solano County is expected to grow more slowly than the region because it already has a large amount of Federal employment at the Mare Island Naval Shipyard and Travis Air Force Base. Sonoma and Santa Clara Counties as separate SMSA's are expected to be rapid growth areas. About 85 percent of new Federal and State jobs should locate in Alameda, San Francisco and Santa Clara Counties connected primarily with federal agencies, or the University of California system and attracted by the more developed urban areas where other agencies are conveniently located and the necessary services and facilities are available for contact with the rest of California or the western regional U. S.

- Wholesale trade projected growth patterns for the region include large declines in San Francisco and fast growth in Alameda and Santa Clara Counties and the smaller counties relative to the regon. This trend reflects a continuation of the decentralization of San Francisco's wholesale trade industry due to high land costs and unavailability of land within San Francisco. Most of the new employment will therefore go to the other large industrialized counties nearby.

- Centralized Urban Manufacturing includes textile mill products, printing and publishing, rubber and plastic products and leather and leather goods. This group should represent about 5 percent of basic employment growth in the region. Projections show the larger, more industrialized counties receiving most of this growth, with Santa Clara getting 30 percent, Alameda getting 25 percent, San Mateo getting 20 percent, San Francisco getting 11 percent, and Contra Costa getting over 7 percent.

- Long Distance transportation industries are railroad, trucking and warehousing, water transportation, air transportation, and pipeline transportation, Projections show a major decline in jobs in this industry in San Francisco. San Mateo County, containing San Francisco Airport, should maintain its importance in the region as the largest employer in this industry. However, Alameda with a very diverse set of transportation facilities is expected to receive the largest gains over the next 25 years, approaching San Mateo Couty by 2000. Santa Clara is the only other county expected to show a large increase in this industry.

- National finance and insurance should account for about 3 percent of new basic employment. San Francisco is expected to receive nearly one-half of this growth because of its position as the financial center of the western U.S. Alameda, San Mateo, Santa Clara and Sonoma Counties will account for the bulk of the rest as these industries tend to locate in highly urbanized areas.

- Petrochemicals and Primary Metals is expected to experience its most significant growth in Contra Costa County with 57 percent of the new jobs. Solano County should also grow in this area based on its proximity to Contra Costa's large installations and the availability of large tracts of vacant land. Alameda, San Francisco, San Mateo and Santa Clara Counties currently have large concentrations of petrochemical and primary metal employment, but will receive only modest growth in this area.

- Decentralized urban manufacturing includes food and kindred products, lumber and wood products, furniture and fixtures, paper and allied products, clay, sand and glass products, etc. Employment in these areas is expected to decline in the Bay Area over the next 25 years. The major decline will be in San Francisco.

- Agricultural employment will also decline in the area. Only Napa and Solano Counties are expected to gain employment in this industry with Santa Clara and Alameda declining most rapidly due to intense development pressures on relatively large acreage in these counties.

IV.F. Sacramento Area Summary

The Sacramento Area is composed of Sacramento County and those portions of Placer, El Dorado, and Yolo Counties closest to the City of Sacramento. Although these form a metropolitan area around Sacramento City the constituent counties do have some basic dis-

tinctions. Taking the region as a whole the most important industry group is government, because Sacramento is the capital city of California. Government employs more than 36 percent of all area workers in 1970, or 108,100 people. Next in importance are services and trade which are partly population-serving industries and partly serve the State government offices and the tourist trade which the state capital attracts. Together trade and services make up nearly 40 percent of total area employment. Manufacturing made up about 15 percent of total employment in 1960, but by 1970 had lost some significance and now represents only about 8 percent of total area employment.

With the capital of the state located in Sacramento, government will continue to be the leading employer and the mainstay of the local economy. The federal government is also an important employer in the area. About 9 percent of the area's total employment is at the three military bases in the City of Sacramento -- McClellan Air Force Base, Mather Air Force Base, and the Sacramento Army Depot. The unique character of McClellan and Mather may make them more stable than some military bases, but their future employment levels cannot be projected with any degree of accuracy.

Retail and wholesale trade are expected to continue to be a strong and growing factor in the economy, continuing to grow at the same rapid rate as in the 1960's. Services, now the third largest employer in the metropolitan area will continue to be the most rapidly expanding part of the economy. Sacramento has historically had a greater service orientation than the rest of California because of growing up around the state capital. Services will make up an increasing percentage of area employment through 1995.

As the center of an agricultural area, much of the manufacturing activity in the Sacramento metropolitan area is tied closely to agriculture, with the dairy industry, food packers, and canners all important employers. Over 6,000 people are employed year round in agriculturally related manufacturing, and almost double this number work at the peak of the packing and canning season. This industry should continue to grow through the next 25 years.

Recent trends indicate that the greatest growth in manufacturing will be in medium to light industry such as mobile home and furniture manufacturing Most of this industry will be attracted to the area from the eastern and mid-western United States, coming to Sacramento because of the good market potential, distribution facilities, and living envrionment of the Sacramento region.

Agricultural output in the area has maintained high levels. However, mechanization, resulting in dramatically increased productivity has been responsible for decline in farm employment, and agricultural employment is expected to continue to drop.

Education is also an important area employment group. UC Davis employs over 4,000 people and attracts other employers such as research firms and institutes and development industries to the area. The University has created a population and employment center which is growing in importance for the region. Sacramento State College is also a significant employer with 1,500 workers. There are also four community colleges in the area employing a total of 13,740 people.

Although total employment in the Sacramento area is expected to grow at about half the pace of the 1960's, the future growth is expected to be steadier and more diverse with a shift toward the service industries.

IV.G. San Joaquin Area Summary

San Joaquin County had a total employment level of 18,400 in 1970. The main employment center for the county is Stockton which dominates the county seat, and is the hub of rail and highway transport. The Port of Stockton is another major employment factor. Trade, manufacturing and public administration activities dominate the economy, with agriculture taking a relatively minor role. There are now three military installations: a Naval annex, an annex of Sharpe General Depot, and an Army Aircraft Maintenance service center. The processing of agricultural products (for example Heinz and Ralston Purina Company) dominates the manufacturing sector.

Lodi is the second largest city in the county and is the major trading center for the northern half of the county. It is located in an important grape and wine producing area. Many Stockton workers live in Lodi. Trade and manufacturing dominate its economy. Most manufacturing is in the food processing group; for example, General Mills, Goehring Meats, and Stokeley-Van Camp are located here.

Tracy is the third largest city in the county. Originally a railroad town, Tracy's economic activity has been dominated by farming for many years, with tomatoes being the most important crop. Food processing is an important industry here. The largest employer in the area is the federal government at Sharpe General Depot, which employs about 2,000 workers. Tracy has recently become a residential community for people working in the Livermore area because of good automobile accessibility to the Bay Area via highways 5, 50 and 580. Other activities in or near the city include: the Deuel Vocational Institute, a correctional institution for young offenders; a non-nuclear test explosion laboratory operated by the Atomic Energy Commission, and a major pumping station for the Central Valley Water Project.

Manufacturing and trade employment levels in the cities and towns of San Joaquin County are approximately proportionate to the population levels,

indicating a high degree of population-serving employment. Recently some employment concentration has been shifting away from Stockton towards the Tracy area. Tracy and Lodi are becoming more important relative to Stockton as trade areas.

The most important employment sector in San Joaquin County in 1970 was trade, with 21 percent of total employment. Manufacturing was second with 15.8 percent, and transportation was close fifth with 8.0 percent.

Agriculture, although a strong industry, is declining in employment because of mechanization. As in most areas of California, the services sector of San Joaquin's economy should be the fastest growing in terms of employment. The government sector employment is difficult to predict because of its dependence on military decisions. Manufacturing is projected to grow at a moderate rate.

The Port of Stockton, an important center for the county, has been declining significantly and the influence of the Port in industrial location decisions has lessened. Partly to balance the decreased terminal activity in the Port, emphasis has been put upon expanding the Port's nationwide warehousing and distribution service over the past eight years. It should be able to attract a significant amount of this type of activity in the future through good facilities. For the future, the Port of Stockton will essentially be a satellite port to Oakland transferring containers to barge or truck, the Port of Sacramento having usurped most of the San Joaquin Valley local port activity. The Port of Stockton will continue as a warehousing and industrial park center, but not an important transport center. Stockton's historical role as distribution center for the Mother Lode country has also been partly usurped by Sacramento and other areas, but some federal and state facilities serving the Mother Lode areas will continue to be centered in Stockton such as the State Highway Department District Office and the Federal Aviation Administration.

In general, therefore, San Joaquin County is not expected to experience rapid employment growth over the next 25 years. The two very general types of activity which will be attracted to the county are decentralized manufacturing and processing, and warehousing and distributing. Much land is available for rail oriented and air oriented industry, but truck oriented developed industrial land is in short supply so that air and rail oriented industries will be the ones most attracted to the area in the near future.

IV.H. Delta Region Summary

The Delta Region is a special resource for the San Francisco/Sacramento area. It is an important agricultural and recreational resource with a delicate environmental balance unduplicated elsewhere in California. The Delta is the focal point where the fresh waters of the Central Valley rivers combine with the salt waters of

San Francisco Bay.

Rice and asparagus are the major crops in the area. Rice is milled in Sacramento where it is transported by river. The area also serves for sheep and cattle grazing.

Tourists and recreators are attracted to the Delta area for fishing, waterskiing and boating primarily. An estimated 5,700,00 recreation days will be spent in the Delta area in 1973, making it one of California's major recreation areas. During the summer season present facilities are usually overtaxed. Twenty-five percent of Delta visitors come from Southern California.

The Delta's significance to the region is as a natural resource for agriculture and recreation not as an employment center. In 1970 the Delta region employed about 1,300 people. This level should about double by 1995, so that the Delta will still represent only a small percentage of regional employment.

V. ALTERNATIVE FUTURES

While there may be general agreement on the total regional population there are sharp differences on the forecast of how this population will locate itself within the region. The number of persons by age within each county is now known and the natural increase, that is the excess of births over deaths, can be calculated by the cohort component method. There is general agreement on the results of this calculation. Assumptions about migration among counties however, vary because of the large number of factors involved. Population growth within a county or district (which is our sub-unit within a county) may be limited by the amount of available and useable land. ABAG assumed that many of the older areas around San Francisco Bay would be limited by this availability of land. A second major factor is accessibility. Generally forecasts have assumed that the same relationship would exist among counties and districts in 1995 as in 1970 relating to accessibility. Major economic locators such as industries, military installations, educational facilities and new towns will locate within the region, but could be attracted to one county or another because of the availability and cost of land, housing and amenities for employers, tax rates, the location of resources or labor force, and a variety of other factors. To a large extent the newer industries of the Corridor Region concentrating in new technology are footloose and can locate virtually wherever they desire.

The economic development, the creation of housing and the resulting population may be encouraged or limited within various counties and districts because of the attitude of present residents. Throughout the Corridor Region, especially in urbanizing communities around the Bay, there is a new recognition of the environmental impacts of development and concern for limiting these impacts. There has been a call for the improvement of the "quality of life" even at the expense of the economic growth. Regionally these concerns have manifested themselves in the support of a rather strong council of governments, the Association of Bay Area Governments, in the creation of the Bay Conservation and Development Commission, in strong regional bodies concerned with air pollution and water quality and with overwhelming support last fall for the creation of coastal conservation commissions.

Because of the factors listed above there is considerable uncertainty about the future geographical distribution of population and economic activities. To a lesser extent there is also uncertainty about the total level of these activites at some future point in time. These uncertainties, created by limitations in forecasting techniques but more importantly by changing societal values and public policies, must be incorporated into the study process. This is best done by the development of a series of "Alternative Futures" which describe a reasonable range of possible small area population and employment projections. This range of projections can then be used to evaluate the transport and land development implications of the alternative transportation improvement programs.

V.A. The Three Futures

From the range of possible factors influencing future socio-economic patterns key variables have been chosen and placed into three combinations which appear to bracket the reasonable range of possible future development patterns. The three variables are:

- o Moderate population growth versus low population growth--the moderate growth rate is that determined by using Series D of the state's projections, while the low rate is between Series D and E (i.e. the ABAG "Low" projection for the nine County Bay Area and between the Series D and E projections for Sacramento and Stockton Areas).

- o Continued southern growth versus a northern tilt within the Bay Area--the trend of growth is centered around San Jose at the present time; policy actions such as the recent building permit limitation may place more pressure on the northern portions of the Bay Area, principally centered around Santa Rosa. ABAG has made projections for both possibilities within the concept of a moderate growth rate.

- o Cities-centered versus dispersed--In contrast to the present trend of new development going into low density subdivisions on previously agricultural or rural lands, policy actions may be taken by existing cities to revitalize themselves and avoid "leap frogging" and provide for a higher density within already urbanized areas. The California Statewide Transportation Study uses city-centered concept, while the ABAG guide lines assume continued dispersal.

From all the possible combinations of these three factors three "reasonable extremes" have been chosen for sensitivity testing designed to demonstrate the different impacts on the region, on counties and on districts of forecasts at each extreme and a forecast more likely to follow present trends. The alternative futures have these characteristics:

Alternative Future One - Low Dispersed -- The low dispersed Future One is essentially a continuation of present trends and implies little change in the way of policy actions. It's likelihood will depend in large degree on the future course of the birth rate and state immigration.

- o Assumes a low growth rate

- o Development would continue to concentrate in the southern portion of the Bay Area

- o New growth will be dispersed at a low density into currently open or agricultural land

Alternative Future Two - Moderate Dispersed--A moderate dispersed future reflects a possible increase in the birth and in-migration and Bay Area regional policy changes to shift the emphasis of new development.

- o Assumes a moderate growth rate
- o A new emphasis would be placed on development in the northern portion of the Bay Area (even though the majority of growth would still be southern)
- o New growth will be dispersed at a low density consistant with current trends and only a moderate level of environmental or development controls.

Alternative Future Three-Moderate City-Centered--The moderate city-centered future reflects a possible extensive regional effort to create and enforce strong development controls and to preserve open space and environmentally sensitive areas.

- o Assumes a moderate growth rate
- o A new emphasis would be placed on development in the northern portion of the Bay Area (both of these points similar to future two)
- o New growth will be city-centered, in all three areas of the region, occuring by infilling or as an orderly extension of existing development.

The assumptions used in creating these alternative futures are detailed in figure 12.

Additional alternative futures may be developed in the course of this study. The low forecast could be developed on the basis of a concentration on existing cities. The low growth rate assumption however, is not likely to result in a northern tilt to Bay Area growth as many of the pressures for additional land will be relieved. In the development of each alternative future, relative accessibility is assumed to remain constant as a base condition against which to test alternative transportation improvement. Upon the creation of alternative transportation modes it may be desirable to modify alternative futures based upon the impacts of such transportation modes in the allocation of population among and within the counties of the Corridor Region.

Figure 12a

ASSUMPTIONS OF ALTERNATIVE FUTURES

REGIONAL			
o Birth Rate	2.35±	2.45	2.45
o Not In-Migration to State	100,000	150,000	150,000
o Overall Environmental Limits	No environmental contraints	No environmental contraints	Strong environmental constraints
DISTRICT			
O Northern Tilt	Continued emphasis on southern portion of Bay Area	New emphasis on northern counties to relieve pressure on sourthern Bay Area	
o Redevelopment of Existing Urban Centers	Continued low level of effort	Continued low level of effort	Renewed effort to revitalize existing centers - Extensive in-filling of recent suburban growth
o Densities of Urban Growth: Urban Suburban	Moderate density infill (10 - 12 DU/acre) Low density (as prevailing) infill (4 - 5 DU/acre	Moderate density infill (10 - 12 DU/acre Low density suburban infill (5 - 6 DU/acre) and low density expansion 4 - 5 DU/acre	High density infill (15 - 20) DU/acre Moderate density suburban infill (6 - 8 DU/acre Some suburban expansion at 4 - 5 DU/acre
o Land Utilization	Limited to developable land preserve some open space	Develop some marginal land and convert agriculture, little space preservation	Preserve large amounts of open space and agriculture, use by passed parcels
o Accessibility	Continued reliance on automobile with moderate road construction, primarily to northern counties	Continued reliance on automobile with extensive road construction, primarily to northern counties	Less emphasis on auto with few roads; more reliance on transit

Figure 12a (cont.)

ASSUMPTIONS OF ALTERNATIVE FUTURES

o Local constraints on Growth and Development	Some pressure taken off because of lowered demand, but efforts to prevent dispersal will occur in selected areas where sufficient non-constraint is available	More intensive efforts to constrain development, but these will be overriden for much of the region	Most extensive constraints on new development will result in renewed emphasis on city centers, but overall region will be allowed to grow.
o Level of Development Controls			
o Sewer Connection Policy	Not always required in new areas	Not always required in new areas	Mandatory connection
o Trunk live extension	Extended upon request	Extended upon request	Extended only within unganized area
o Open space dedication	Not required	May be required in some areas	Required throughout region
o Zoning controls	Present trends	Some density restrictions	Emphasis on planned unit development
o Enforcement levels	No special effort	Some correction shown	Extensive enforcement of laws
o Method of achieving goal	Present trends continue in planning and zoning but: o Expand programs for family planning o Initiate manpower programs to employ the locally unemployed rather than hiring workers from outside the region o Discourage present programs of industrial and economic development	North Tilt emphasis assumes: o ABAG adopting Northern Tilt Policy o Use of ABAG general planning A-95 Review Authority to prevent portion of new growth in the south o State provision of highways in northern Bay Area (and not in southern) o Improved rapid access from north to San Francisco, Sacramento and Stockton o Consideration of imposed development limits in regions suffering from air and water pollution	City Centered emphasis assumes: o Establishment of urban expansion areas based on general plans of cities, counties and regional councils o Policy to annex territory and provide utilities only within urban expansion areas o Amend tax laws to discourage urban assessment of non-urban land, thus resulting in conversion o Amend revenue system to allow all jurisdictions to share in economic growth of region

Figure 12a(cont.)

ASSUMPTIONS OF ALTERNATIVE FUTURES

City-Centered emphasis assumes: (cont.)

- o State restriction of development on envrionmentally sensitive land
- o State and regional programs to acquire or preserve open space and prime agricultural land
- o Plan and provide transportation only to city centered areas

V.B. Sub-Area Assumptions and Holding Capacity

For purposes of the initial study, the Corridor area, which consists of 13 counties, has been divided into 43 "districts" varying in geographic and population sizes. These districts are compatible with statewide transportation study zones, COG zones and census tracts. Generally the districts consist of three types: 1) central cities and already urbanized areas, 2) urbanizing areas with a high potential for growth and 3) rural and recreation areas expected to have slow growth rates. These are shown in figure 13.

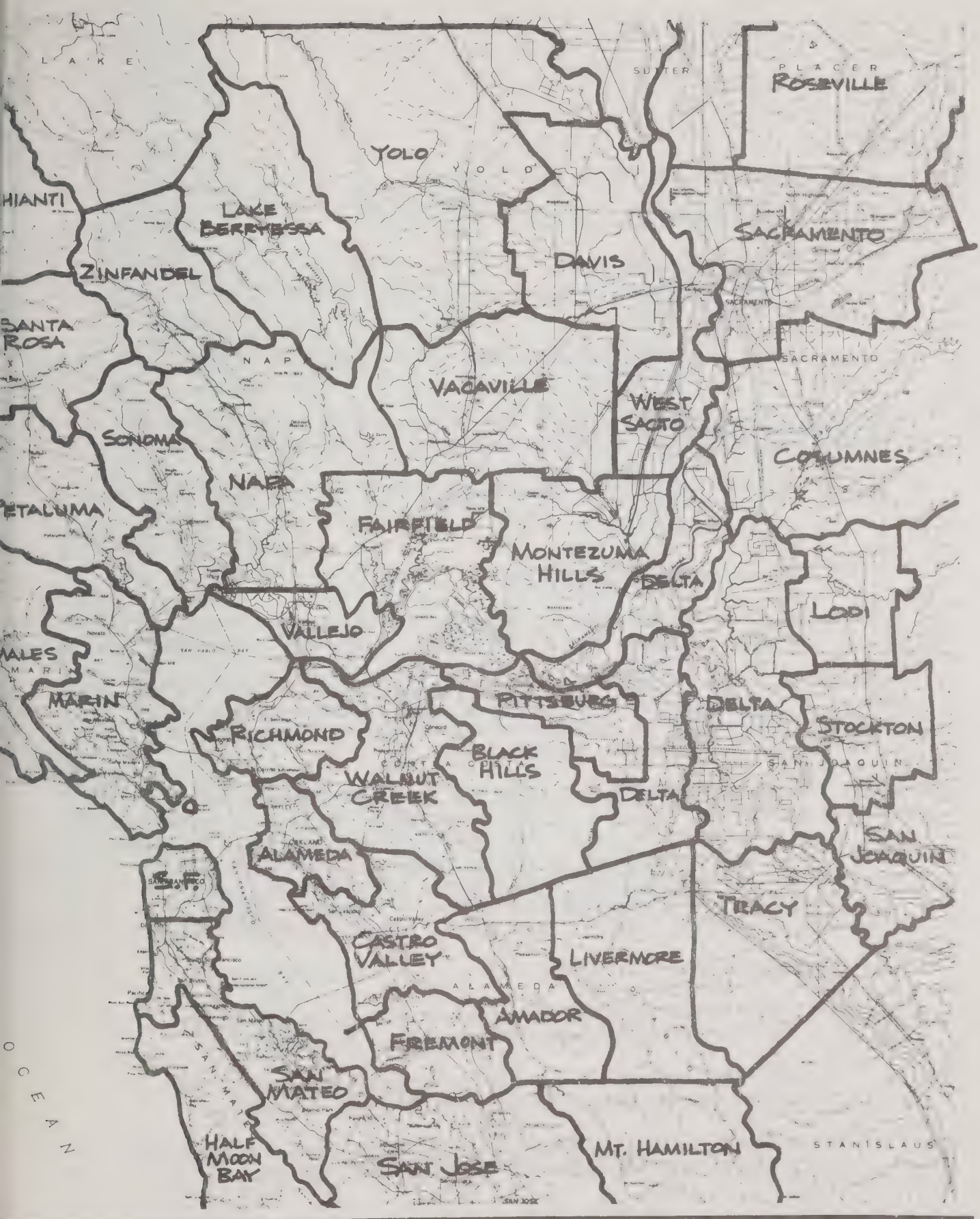
The population and employment forecasts are prepared on the basis of those alaternative futures which assume different rates of growth for the Corridor Region as a whole and different patterns and location within the region. The future patterns may respect environmental suitability or they may continue past trends. A measure of the potential problems and opportunities has been generated through the development of an environmental holding capacity analysis which is used to generate Alternative Future Three.

This procedure calculated the acreage available for development of the factors in the suitability analysis carried out in section IV. In analyzing the Suitability for Development, it is apparent that major development opportunities exist in three general categories:

Existing Urban Infill--Relatively high density development accomplished through building on vacant incorporated land or through redevelopment/ renewal processes. All urban areas possess this capability to varying degrees and quantities.

Infill Between Existing Urban Areas--Suburban infill (sprawl) on unincorporated land. Prime areas include:

- Novato Valley
- Petaluma Valley
- Sonoma Valley
- Santa Rosa Valley
- Napa Valley
- Pope Valley
- Suisun Valley
- San Ramon/Amador Valley



SACRAMENTO·STOCKTON·SAN FRANCISCO BAY AREA·CORRIDOR STUDY			13
DISTRICTS	0 5 10 15 20 25mi	AMV	
		DRA	
		EDAW	4-27
		KE	

- Santa Clara Valley
- near Union City
- Fremont-Milpitas area
- Livermore Valley
- Route 50 and 80 corridors-northeast of Sacramento

Outlying, Rural, Expansive Areas -- Open for a variety of opportunities from new twon development to rural residential. Prime areas include:

- Northeast slopes of Diablo Range adjacent to Interstate 5
- Montezuma Hills
- Portions of Sierra Foothills
- Portions of the Central Valley around Stockton, Woodland, Davis, Vacaville, east of Elk Grove, northwest of Roseville

Urban infill is an ongoing process that is certain to continue. Infill between existing urban areas is a present trend that is likely to continue. Development in outlying, rural areas is not likely unless guided by strict development controls.

Figure 14 records the acreage suitable for development within each statistical district in the study area. Asterisks denote that the statistical district boundary is larger than that studied. This table indicates a first round approximation of acreage available for development in non-urbanized areas if a strict environmental position were assumed. As a result, the available areas are considerably smaller than those calculated by ABAG and others. These are explained by several factors:

- Study criteria were uniformly applied with no weighting
- Urban areas were deleted in this round despite recognition that they offer suitable development opportunities
- Scale of analysis necessarily overstates constraints. Detailed work in Phase II will enlarge areas of concern
- Areas that posed difficulties to development were included as well as those which involved environmental impacts.

Figure 14

DEVELOPMENT SUITABILITY, ACREAGE PER STATISTICAL DISTRICT

COUNTY Statistical District	Suitable Acres
ALAMEDA	
Alameda	1,153.8
Castro Valley	961.5
Fremont	7,980.5
Amador	2,980.7
Livermore	38,556.6
CONTRA COSTA	
Richmond	2,211.5
Walnut Creek	6,922.9
Pittsburg	21,537.8
Black Hills	12,980.4
Delta	38,748.9
MARIN	
Marin	8,557.4
Tomales*	1,730.7
SANTA CLARA	
San Jose	11,345.8
Gilroy*	0
Mt. Hamilton*	0
SOLANO	
Vallejo	7,642.1
Fairfield	34,806.6
Vacaville	115,528.5
Montezuma Hills	79,420.7
SONOMA	
Santa Rosa*	14,518.8
Petaluma*	50.766.9
Sonoma	24,614.7
Chianti*	0

Figure 14 (cont.)

COUNTY Statistical District	Suitable Acres
YOLO	
West Sacramento	36,921.9
Davis	64,709.6
Yolo*	133,169.1
NAPA	
Napa	21,730.1
Zinfandel*	3,557.6
Lake Berryessa	10,576.6
PLACER	
Roseville*	54,229.2
SACRAMENTO	
Sacramento	44,902.5
Cosumnes	191,725.1
Delta	26,441.5
SAN FRANCISCO	0
SAN JOAQUIN	
Stockton	39,421.9
Lodi	50,286.9
Tracy	65,478.8
Delta	116,727.3
San Joaquin*	264,794.9
SAN MATEO	
San Mateo	1,249.9
Half Moon Bay*	0

Major differences between ABAG and SSSFBACS suitability figures occur in the filling areas where a conservative position was taken.

- Kentfield, Fairfax and Novato in Marin County where slope, landslide and soil instability constraints were strictly observed.

- Danville area in Contra Costa County where slope constraints were projected.

- Amador/Pleasanton area of Alameda County where slope and air pollution constraints impose intrinsic unsuitability.

The suitability analysis-derived environmental capacity figures establish an extreme against which projected development quantities and patterns can be tested--particularly whether and/or the degree to which transportation influences development in respect to the holding capacity.

Environmental impacts of future transportation improvements, especially those induced by transportation improvements will be influenced by these major factors:

- The ability of the state and local government to implement and enforce its environmental goals and policies

- Environmental awarenesson the part of landowners, developers, real estate concerns and banking and lending institutions

- Generation of interest and insistence among the people of the region in development practices based on land capability and applied ecology.

The degree to which these three factors play a stong role in regulating future development patterns is an important component of the uncertainty surrounding "alternative futures"--as is the transportation influence on the patterns. Alternative Future Three was developed respecting the holding capacity figures reflecting an assumption of a strong environmental policy orientation.

V.C. District Activity Distribution

The results of alternative future forecasts are detailed in figure 15, which provides 16 items of information on each county and district. The 1970 base line figures for counties is that of the July 1st population estimate of the State Department of Finance, which relates directly to the population forecasts provided in figures 8 through 11. The 1970 population for districts is that of the 1970 census as determined by the State Wide Transportation Study.[1]

[1]Separate district discussions are presented in Appendix B.

The 1995 population forecast is provided for each of the three alternative futures. In addition, for each of these alternatives the 1970-1995 percentage change in population has been calculated. The percentage share of each county shown for districts, and share of the region for counties, demonstrates the impact of the several alternatives.

The alternative futures forecasts have used, to the extent possible, existing and current forecasts of the state and regional bodies. In several significant areas, however, changes have been made to reflect current activity and community concerns shown in individual districts. These changes are detailed in figure 15. A graphic expression of the activity distribution associated with each future is shown in figures 17-19.

County and district-level implications of each alternative future in terms of the location of future population for each future have been prepared. They are available as Appendix B.

Figure 15

ALTERNATIVE FUTURES FORECASTS

COUNTY DISTRICT	# 1 - LOW SOUTH DISPERSED (Present Trends) Percentage Of Region	Area	County	% Growth Over 1970	Total Pop	#2 - MODERATE NORTH DISPERSED Percentage Of Region	Area	County	% Growth Over 1970	Total Pop	#3 - MODERATE NORTH CITY-CENTERED Percentage Of Region	Area	County	% Growth Over 1970	Total Pop	1970 Baseline
ALAMEDA	17.5	21.8	100.0	29.4	1393.0	16.1	19.9	100.0	30.2	1401.2	16.7	20.6	100.0	34.8	1451.0	1076.1
Alameda			42.7	3.0	594.3			42.5	3.3	596.0			45.1	17.0	654.9	576.9
Castro Valley			22.6	14.3	314.8			23.2	17.9	324.9			22.9	20.5	331.9	227.5
Fremont			14.6	42.3	203.6			14.7	43.5	205.3			20.2	104.5	292.7	143.1
Amador			14.5	445.3	202.3			13.8	422.6	193.9			6.9	169.5	100.0	37.1
Livermore			5.6	92.6	78.0			5.8	100.2	81.1			4.9	151.8	71.5	40.5
CONTRA COSTA	11.2	13.9	100.0	59.7	891.4	10.8	13.3	100.0	68.0	937.4	10.6	13.1	100.0	65.5	923.8	558.1
Richmond			27.7	33.1	246.7			27.3	38.5	256.1			34.9	74.1	322.0	184.9
Walnut Creek			54.4	69.7	485.0			51.1	67.7	479.3			46.3	49.8	428.1	285.8
Pittsburg			16.3	100.7	145.3			19.9	157.5	186.4			17.1	117.7	157.6	72.4
Black Hills			1.1	9.7	10.2			1.2	18.5	11.0			1.2	21.5	11.3	9.3
Delta			0.5	13.9	4.1			0.5	27.8	4.6			0.5	33.3	4.8	3.6
MARIN	3.6	4.5	100.0	38.7	287.8	4.0	5.0	100.0	69.4	351.4	3.7	4.5	100.0	54.2	320.0	207.5
Marin			98.4	40.5	283.3			98.5	71.6	346.2			98.4	56.1	314.8	201.7
Tomales			1.6	(12.0)	4.4			1.5	4.0	5.2			1.6	4.0	5.2	5.0
NAPA	1.8	2.3		82.8	145.7	2.6	3.2	100.0	185.3	227.4	2.0	2.4	100.0	114.2	170.7	79.7
Napa			86.2	92.8	125.7				207.7	200.6			86.4	126.2	147.5	65.2
Zinfadel			12.9	41.4	18.8				87.2	24.9			12.0	53.4	20.4	13.3
Lake Berryessa			0.8	100.0	1.2				316.7	1.9			1.6	366.7	2.8	2.8
PLACER	1.5	10.5	100.0	59.9	12.3	1.6	11.2	100.0	76.5	137.5	1.4	9.9	100.0	55.7	121.3	77.9
Roseville *			80.1	59.4	97.2			80.1	75.9	110.1			80.1	55.3	97.2	62.6
SACRAMENTO	11.0	75.9	100.0	37.6	877.0	10.6	74.7	100.0	44.2	919.0	10.8	76.7	100.0	48.2	944.7	637.5
Sacramento			94.7	37.6	830.5			94.7	44.2	870.5			94.8	48.4	895.9	603.6
Cosumnes			4.8	61.0	41.7			4.7	67.6	43.4			4.6	68.7	43.7	25.9
Delta			0.5	2.1	4.8			0.6	8.5	5.1			0.5	8.5	5.1	4.7
SAN FRANCISCO	9.1	11.3	100.0	1.1	722.3	8.3	10.2	100.0	1.3	723.4	8.4	10.3	100.0	1.8	727.0	714.3

* Use Roseville district only in area and regional totals

Figure 15 (cont.)

ALTERNATIVE FUTURES FORECASTS

COUNTY DISTRICT	#1 - LOW SOUTH DISPERSED (Present Trends) Percentage Of Region	Area	County	% Growth Over 1970	Total Pop	#2 - MODERATE NORTH DISPERSED Percentage Of Region	Area	County	% Growth Over 1970	Total Pop	#3 - MODERATE NORTH CITY-CENTERED Percentage Of Region	Area	County	% Growth Over 1970	Total Pop	1970 Baseline
SAN JOAQUIN	5.0	100.0	100.0	36.6	397.1	4.8	100.0	100.0	44.0	418.6	4.8	100.0	100.0	44.0	418.6	290.7
Stockton			62.6	38.1	248.5			62.1	44.3	259.8		64.5	64.5	50.0	270.0	180.0
Lodi			14.0	39.7	55.6			13.9	46.5	58.3		13.3	13.3	39.7	55.6	39.8
Tracy			8.0	46.3	31.6			8.0	54.6	33.4		7.5	7.5	46.3	31.6	21.6
Delta			1.2	(8.0)	4.6			1.1	(8.0)	4.6		1.1	1.1	(8.0)	4.6	5.0
San Joaquin			14.3	32.1	56.8			14.9	45.1	62.4		13.6	13.6	32.1	56.8	43.0
SAN MATEO	9.4	11.7	100.0	38.3	746.9	8.0	9.9	100.0	25.9	700.7	8.9	11.0	100.0	39.4	776.0	556.7
San Mateo			95.7	34.7	715.0			94.9	22.1	664.7			95.3	35.8	739.4	544.6
Half Moon Bay			4.3	166.7	32.0			5.1	200.0	36.0			4.7	205.0	36.6	12.0
SANTA CLARA	19.8	24.7	100.0	46.7	1576.4	18.1	22.4	100.0	47.0	1579.9	18.1	22.3	100.0	46.7	1576.7	1074.8
San Jose			95.6	45.6	1507.4			94.5	44.2	1493.6			95.6	45.6	1507.6	1035.5
Gilroy			4.3	127.9	67.9			5.5	185.9	85.2			4.3	127.9	67.9	29.8
Mt. Hamilton			0.1	0.0	1.2			0.1	0.0	1.2			0.1	0.0	1.2	1.2
SOLANO	3.6	4.5	100.0	64.2	285.0	5.5	6.8	100.0	176.2	479.4	5.3	6.5	100.0	165.1	460.2	173.6
Vallejo			44.4	50.8	126.4			32.1	83.5	153.8			44.0	141.6	202.5	83.8
Fairfield			35.6	99.2	101.4			50.7	377.6	243.1			38.5	247.9	177.1	50.9
Vacaville			18.6	60.6	53.3			16.3	137.3	78.3			16.6	131.5	76.4	33.0
Montezuma Hills			1.5	2.4	4.2			0.1	2.4	4.2			0.1	2.4	4.2	4.1
SONOMA	4.3	5.4	100.0	67.9	344.5	7.5	9.3	100.0	220.3	657.3	7.5	9.2	100.0	218.1	652.7	205.2
Santa Rosa			46.0	81.9	158.6			53.1	300.0	348.8			58.8	340.0	383.7	87.2
Petaluma			28.9	121.4	99.4			29.1	326.3	191.4			27.0	292.6	176.3	44.9
Sonoma			8.9	27.4	30.7			5.5	50.6	36.3			5.5	49.4	36.0	24.1
Chianti			16.2	14.8	55.8			12.3	66.3	80.8			8.7	16.7	56.7	48.6
YOLO	2.0	13.7	100.0	71.6	157.9	2.0	14.2	100.0	89.7	174.5	1.9	2.3	100.0	79.3	165.0	92.0
West Sacramento			21.3	15.9	33.6			21.3	27.9	37.1			22.5	27.9	37.1	29.0
Davis		10.0	73.4	108.5	115.9			73.8	131.5	128.7			72.3	114.6	119.3	55.6
Yolo			5.3	16.7	8.4			5.0	20.8	8.7			5.2	19.4	8.6	7.2
TOTAL					7922.2					8680.3					8683.6	

Figure 16

ASSUMPTIONS OF POPULATION DISTRIBUTION

ALTERNATIVE FUTURES

#1 LOW DISPERSED

San Francisco Bay Area:	Uses ABAG "Low" projection for county and district.
Sacramento Area:	Uses State Department of Finance projections for counties (calculated at 37.1% of scale from Series E to Series D).
Stockton:	Uses State projection for county (caculated as for Sacramento). Uses constant 1970 ratio for district allocations.

#2 MODERATE DISPERSED

San Francisco Bay Area:	Uses ABAG "Northern Tilt" projections for Marin, Napa, San Francisco, Santa Clara and Sonoma Counties; Alameda and Contra Costa adjusted to place 15,000 population forming Amador district into new town in Pittsburg district; San Mateo reduced 69,400 to provide increases in Solano County, including new town of 25,000 population. (Solano also assigned 6,700 necessary to make ABAG projections conform to State Series D regional forecast).
Sacramento Area:	Uses State Series D for counties; district allocations similar to Alternative #1 with slightly higher ratio in Davis.
Stockton Area:	Uses State Series D for counties district allocations by California State Wide Transportation Study.

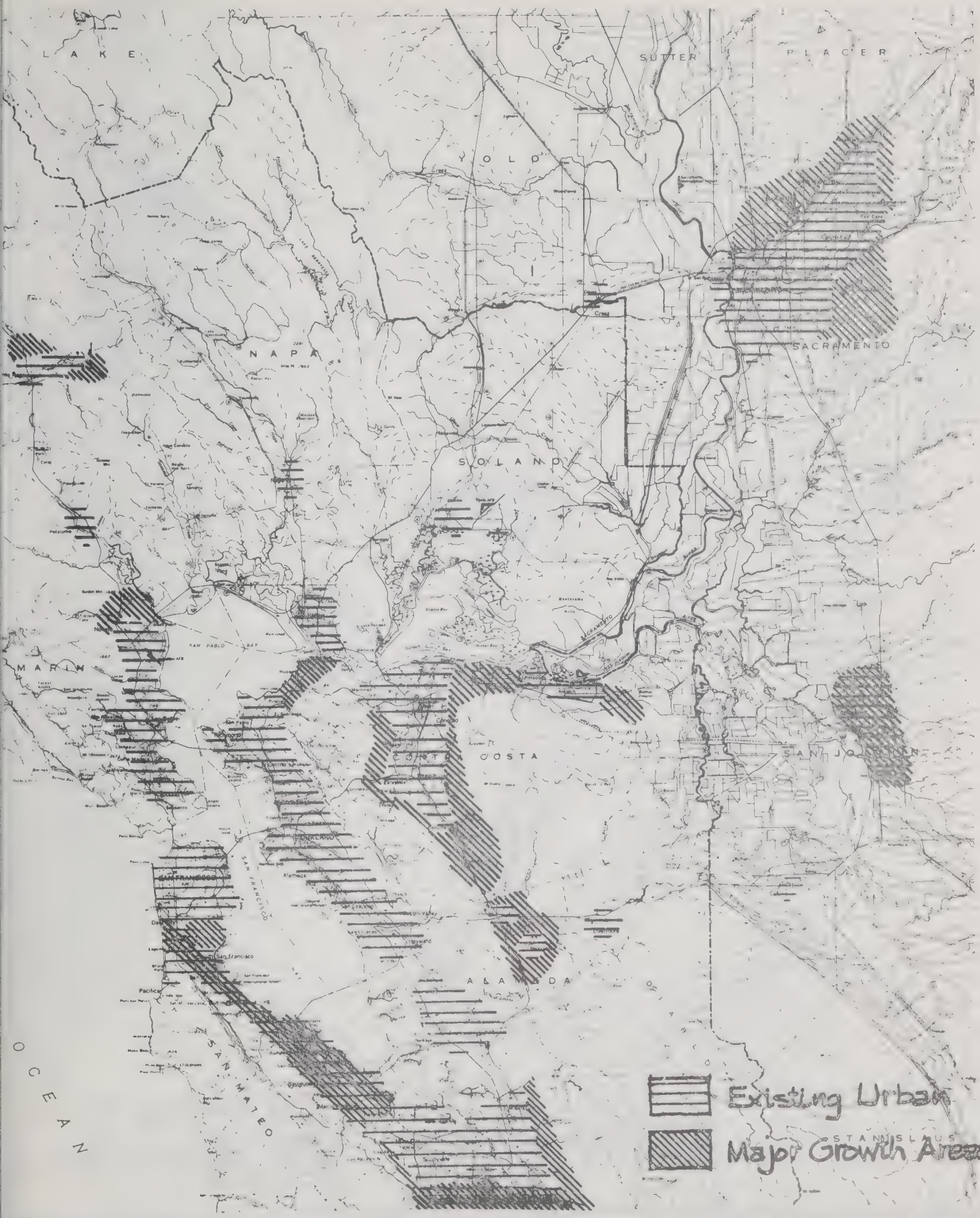
Figure 16 (cont.)

ASSUMPTIONS OF POPULATION DISTRIBUTION

ALTERNATIVE FUTURES

#3 MODERATE CITY-CENTERED

San Francisco Bay Area:	Uses California Statewide Traffic Study for Contra Costa, Napa, San Francisco Counties and districts within; Alameda County - Uses CSTS execpt adds 2,100 in Castro Valley; Marin County limited to 320,000 per County Plan; San Mateo County assigned 75,300 above dispersed alternative; Santa Clara County consistant with Alternatives #1 and #2, with emphasis on San Jose and reduction in Gilroy; Solano County uses CSTS for Vallejo, ABAG guideline for Vacaville and major growth in Fairfield; Sonoma County assumes 10% above dispersed concept for Santa Rosa, lesser growth in Petaluma, ABAG guideline in Sonoma.
Sacramento Area:	Uses State Series D for area total, but places increased emphasis on Sacramento and reduction in Davis.
Stockton Area:	Uses State Series D for county, but assumes all growth above Low (Alternative #1) will go in Stockton.



SACRAMENTO·STOCKTON·SAN FRANCISCO BAY AREA·CORRIDOR STUDY

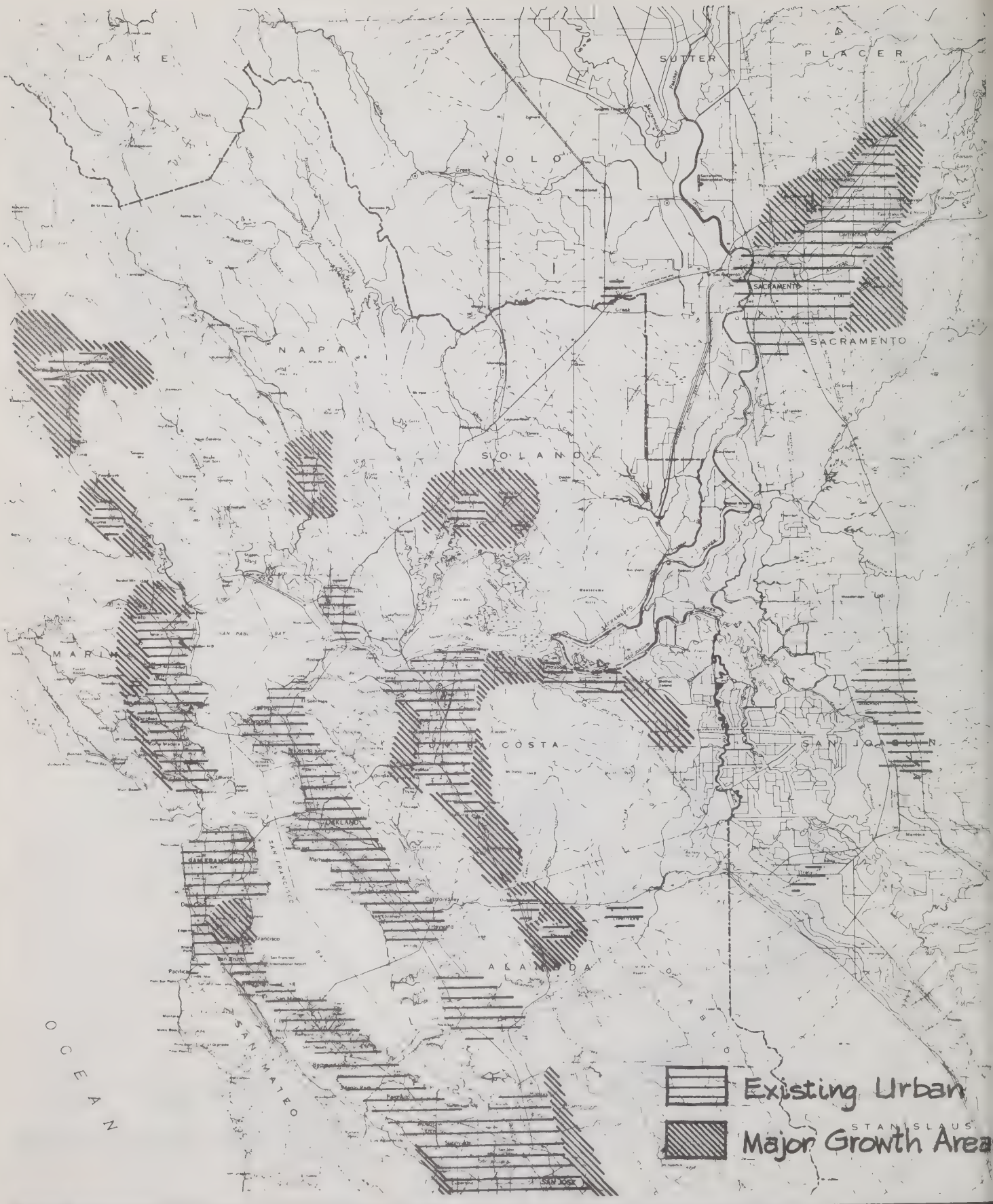
17

ALTERNATIVE FUTURE 1
low growth dispersed

0 5 10 15 20 25mi

AMV		
DRA	4-27	
EDAW		
KE		

55



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SACRAMENTO·STOCKTON·SAN FRANCISCO BAY AREA·CORRIDOR STUDY

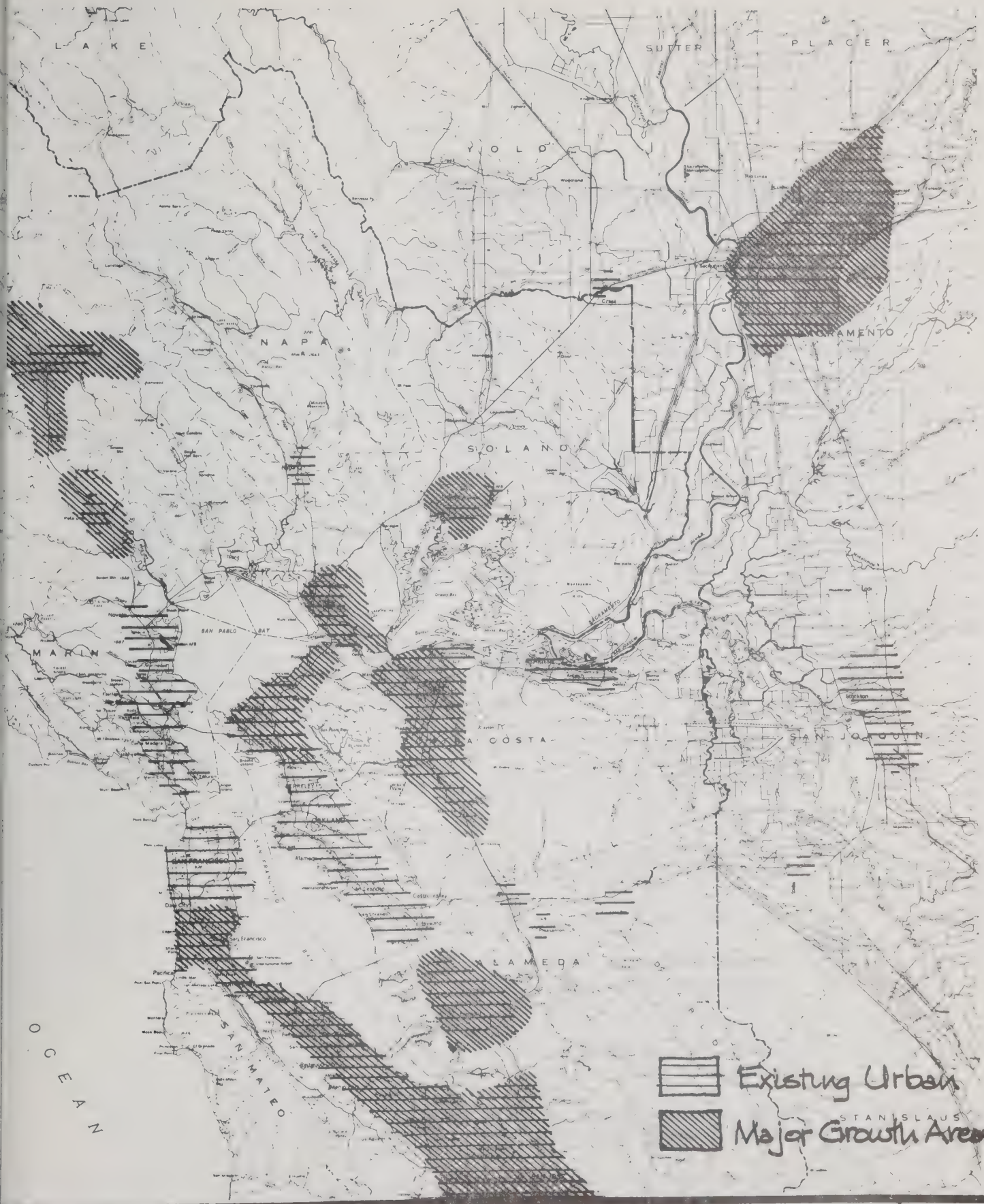
18

ALTERNATIVE FUTURE 2
moderate dispersed

0 5 10 15 20 25mi

AMV	
DRA	4-27
EDAW	
KE	

56



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19

ALTERNATIVE FUTURE 3
moderate city centered

0 5 10 15 20 25mi

AMV	
DRA	4-27
EDAW	
KE	

57

V.D. Summary of Alternative Futures Impacts

The three alternative futures described above have vastly differing impacts on the magnitude and location of population as shown in figure 20. These patterns in turn have environmental impacts associated with them.

Alternative Future One-Low Growth Dispersed--This alternative essentially contemplates a continuation of existing trends as perceived in 1973. While growth would be primarily in the southern portion of the Bay Area and dispersed, the lower level of natural increase and in-migration contemplated will reduce the pressure on the expansion of low-density suburbs on the fringes of the metropolitan area These newer subdivision will capture 26.2 percent of added population to increase their share from 7.7 percent to 12.9 percent of the total regional population. The major loser under this alternative will be the central cities, which will increase only 1.1 percent, with share of population dropping from 22.6 percent to 16.6 percent. Both major cities and older suburbs will maintain their relative share of population, and, in fact, capture a larger share of added population than the newer suburbs.

It is likely that this development will proceed with a low order of environmental controls, in areas which are generally suitable for development. Hazard to life and limb and real property will be minimal. Environmental impacts will be relatively low, but widespread. Degree of impact will be, to a large extent, a question of design quality. Within this framework, impacts of this alternative future will be:

- los of prime agricultural land in San Jose area (outside of the study area)
- continued dependence upon personal automobile with high order of road and freeway construction.
- relatively high material requirements for utility infrastructure.
- expanding commute distances require more time and energy consumption (depletion of fossil fuel resources) and place greater demands on existing highways.
- destruction of large areas of vegetation and wildlife habitats--though not critical ones.
- modification and pollution of natural waterways; covering of acquifer recharge areas
- soil erosion (mostly during construction)
- sterilization of soil
- overuse of chemical pesticides (after habitation)

Figure 20

IMPACTS OF ALTERNATIVE FUTURES

	#1 LOW DISPERSED		#2 MODERATE DISPERSED		#3 MODERATE CITY CENTERED		
Total - 1995 Population	7,922.2	Percent of Region	8,680.3	Percent of Region	8,680.3	Percent of Region	
San Francisco Bay Area	6,393.0	80.7%	7,058.1	81.3%	7,058.1	81.3%	
Sacramento Area	1,132.1	14.3	1,203.6	13.9	1,203.6	13.9	
Stockton Area	397.1	5.0	418.6	4.8	418.6	4.8	
Growth Percentage 1970-1995	38.3%						
San Francisco Bay Area	37.6		51.9		51.9		
Sacramento Area	43.2		52.4		52.4		
Stockton Area	36.6		44.0		44.0		
Share By Districts - 1995							1970 Baseline
Central Cities	1,316.6-	16.6%	1,319.4-	15.2%	1,381.9-	15.9%	22.6%
Major Cities	2,586.4-	32.7	2,623.9-	30.2	2,673.5-	30.8	31.9
Older Suburbs	2,751.4-	34.7	3,018.0-	34.8	3,236.6-	37.3	34.3
Newer Suburbs	1,020.9-	12.9	1,424.7-	16.4	1,130.2-	13.0	7.7
Rural	246.9	3.1	294.3-	3.4	261.4	3.0	3.5
Added Population - 1970-1975							
Central Cities	25.4	1.1%	28.2	0.9%	90.7	3.1	
Major Cities	767.3	34.6	804.8	27.1	854.4	28.8	
Older Suburbs	791.8	35.8	1,058.4	35.6	1,277.0	42.0	
Newer Suburbs	579.5	26.2	983.3	33.1	685.5	23.1	
Rural	49.1	2.2	96.5	3.2	63.6	2.1	
Total	2,213.1		2,971.2		2,971.2		

Source: Development Research Associates

- development is accompanied by large areas of impermeable surface runoff and the need for channelization.

- increased air pollution is a likely consequence dependent upon performance standards.

Alternative Future Two--Moderate Growth Dispersed Concept -- This is based on a "northern tilt" to population growth around the San Francisco Bay Area. The dispersed development pattern will be pressured by a moderate growth rate of natural increase and in-migration higher than at present, resulting in nearly a million new residents (one-third the added population) in new suburbs. The population share of newer suburbs will increase from 7.7 percent to 16.4 percent, again largely at the expense of central cities which will decline from 22.6 percent to 15.2 percent. Older suburbs will increase slightly and major cities decline slightly in share of region population.

It is likely that development controls will increase relative to the increases in numbers and densities. Generally growth will occur in the most suitable areas with the same kinds of impacts as Alternative Future One. But they will be more substantial becuase of increased densities and wider coverage. In addition, the shift of emphasis to the North Bay Cities will have the following specific impacts:

- negative influence on the quality and character of valley centered riparian environments, the Bayside marshes at their outlets, and ultimately the water quality of the North Bay.

- loss of some prime wine producing lands in the Napa, Sonoma and Santa Rosa areas.

- physical development constraints are generally in close locational proximity (i.e. valleys are narrow, are subject to flooding, are contained by steep slopes which are heavily vegetated).

- greater access difficulties to San Francisco, with increased pressure for additional Bay crossings. Similar pressures in Sacramento.

Alternative Future Three--Moderate Growth City-Centered-Less than a fourth of new growth will come in newer suburbs. The highest growth-43.0 percent-will be in older suburbs, followed by major cities. Even under the city-centered concept, the central cities will gain only 3 percent of the added regional population, and their share of regional population will decline sharply. Surprisingly, under the moderate city-centered forecast

more persons will live in suburbs than under the low dispersed concept, because of the general inability to accommodate added growth in the cities. This indicates that the most significant factor in reduced suburban growth--and resulting environmental preservation--will come from reduction in the birth rate and in-migration and not from city-centered or suburban protection policies.

In order for this alternative future to occur, there must be strict development controls to determine the location and nature of development. All development would go in suitable areas and with the envisioned controls, environmental impact would be lower than with the other alternative futures. Significant amounts of open space for recreation, agriculture and conservation would be preserved. In many respects this would be the most environmentally sound alternative.

Perhaps the most important impact of this alternative will be the high level of use that citizens of a dense city centered region would inevitably place on the surrounding open space lands. The balance of these environmental impact considerations is complex and warrants a broader examination than is possible in this cycle.

District Impacts-- The varying impact of alternative futures is even more dramatic, and significant, on individual districts than on the region as a whole. The forecast for Santa Rosa under Future Three is 205,100 more than under Future One. In percentage increase, the difference is a 340 percent growth over 1970 compared to a 52 percent increase. In figure 21 ten top districts under each alternative, in terms of total population added, percentage increase, and difference between the extreme forecasts have been identified and described. In every case, San Jose will have the largest numerical growth. Under Future One, over 20 percent of the new population of the Corridor Region will be added to San Jose. The percentage growth will not be high however because of the extremely large current base.

The Northern Tilt impact is demonstrated by the second ranked position of Santa Rosa in Future Two and Three, compared to a sixth position in Future One. Applying the city-centered concept to the Northern Tilt gives a higher growth to Santa Rosa and propels it into the highest percentage increase in the Region under Alternative Future Three. Without the environmental constraints that alternative imposes, the highest percentage growth comes in the Amaddor district of central Alameda County--between 442 and 446 percent! Half Moon Bay and Gilroy have high percentage growth but on too small a base to be significant. Under each alternative, Fairfield and Petaluma have significant growth forecast.

The differing emphasis on the Northern Tilt and city-centered versus dispersal bring sharp differences in the Santa Rosa, Fairfield, Amador

Figure 22

DISTRICTS TO STUDY IN DETAIL

	Central Cities	Along Corridor	Population Growth #1	#2	#3	Percent Increase #1	#2	#3	Diff. in Forecasts	Environ. Concern
San Francisco	X									
Alameda	X									
San Jose	X		#1	#1	#1					X
Sacramento	X		#2	#3	#3				#10	
Stockton	X		#9							
Santa Rosa			#6	#2	#2	#5	#3	#1	#1	X
Fairfield		X		#5	#9	#7	#2	#3	#2	
Walnut Creek		X	#3	#4	#5					
Amador		X	#5	#6		#1	#1	#5	#3	X
Petaluma				#9	#7	#10	#4	#2	#4	X
San Mateo			#4		#4				#5	X
Vallejo		X			#10			#7	#6	
Napa				#8		#8	#5	#10	#8	X
Pittsburg		X	#8	#10		#6	#8			
Davis		X				#4	#10			X

Source: Development Research Associates

Central Valley residents, on the other hand, view San Francisco as the top overnight destination. The magnitude of these attractions will be investigated during the next cycle.

PART TWO--TRAVEL FORECAST AND EVALUATION

Part One of this report has developed the socio-economic and environmental framework necessary to generate travel forecasts. In addition, it has established the basis for much of the evaluation process--particularly evaluation relating to the effects of transportation on the activity and environmental patterns of the study region.

Part Two briefly surveys the existing transport facilities of the region and their utilization. It describes the nature of intercity travel. The travel forecasting process is then outlined and the dimensions of the intercity market potential are projected.

A variety of base line transportation technologies are reviewed with potential to serve this market and a series of possible improvement options are indicated. From these options several test systems are selected and travel forecasts made.

The impacts of these test systems are evaluated in a preliminary fashion in Section XII, and the next steps for this study are discussed.

VI. EXISTING TRAVEL FACILITIES AND USAGE

Prior to the development of improvement options for the study region a review has been made of the major transportation facilities in the study area. Their current utilization and capacity for expansion are noted below.

VI.A. Auto

Automobile is the dominant mode of travel between the major centers in the Study Region. Figure 23 indicates that 90% of the travel between San Francisco and Sacramento is by car, with similar proportions between all centers. With population increases of 27% and average income increases of 60% in the Bay Region over the last decade, accompanied by an increase in automobile ownership (the average household has 1.13 cars) travel has increased substantially. The BATS predicted an 80% growth in vehicle miles of travel between 1965 and 1985. For a region as large as the nine-county region, approximately one percent or 125,000 trips per day have one end outside the region--"external trips."

For the Sacramento and Stockton area, the trends are similar with a growth in vehicle miles from 15,000,000 to 31,000,000 predicted for the latter in a similar time frame. For these smaller areas, however, about 10% of trips will be external--reflecting to a great extent trips in and out of the Bay Area. (Figure 24 indicates the major highway facilities serving intercity travel.)

The region includes a network of local streets, arterials, highways and limited access expressways or freeways. The major intercity travel serving facilities are interstate routes I-80, I-580, I-680, I-50, I-280, U. S. 101, and State Routes 17, 24, and 4. All of the former and most of the latter are fully access-controlled. Other important routes are State 21, 29, 12, 92, 37, temporary I-505 on U. S. 50.

Improvement programs for the above facilities are currently being revised, but included on-going or planned improvements for I-80, I-580, I-680, and I-5, State Routes 4 and 37.

Figure 25 indicates the current and planned number of lanes for the major intercity highway facilities in the area. The rights-of-way and the median widths, vary considerably over the length of a facility even when the number of lanes is constant.

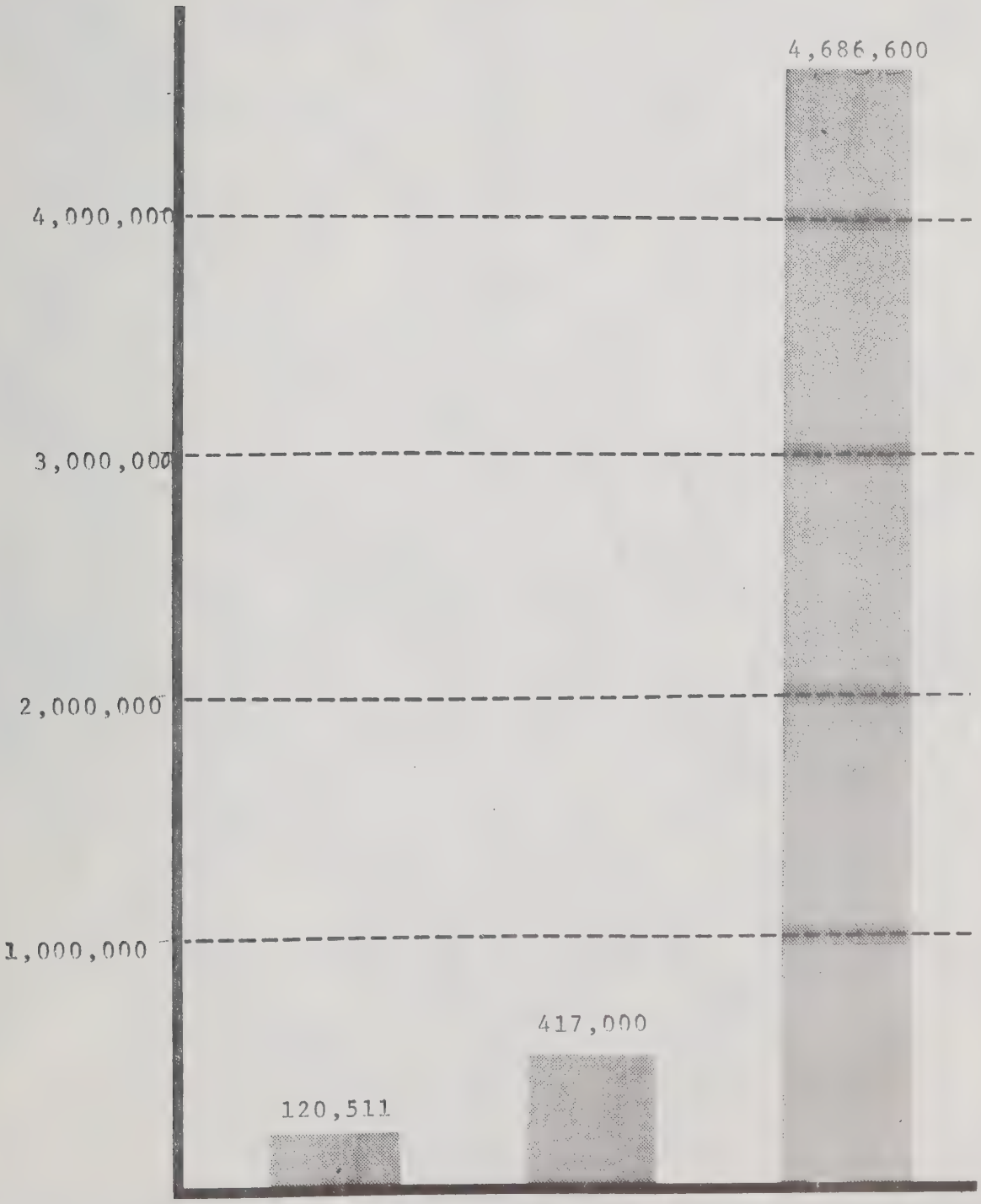
As shown on the Figure , Route 80, the major link between the Bay Area and Sacramento, will have a minimum of three lanes directional when current upgrading is completed. There are no parallel routes to 80 which offer system redundancy or rights-of-way with upgrading or alternative mode potential other than the two-lane route 130 and 160 or the railroad rights-of-way.

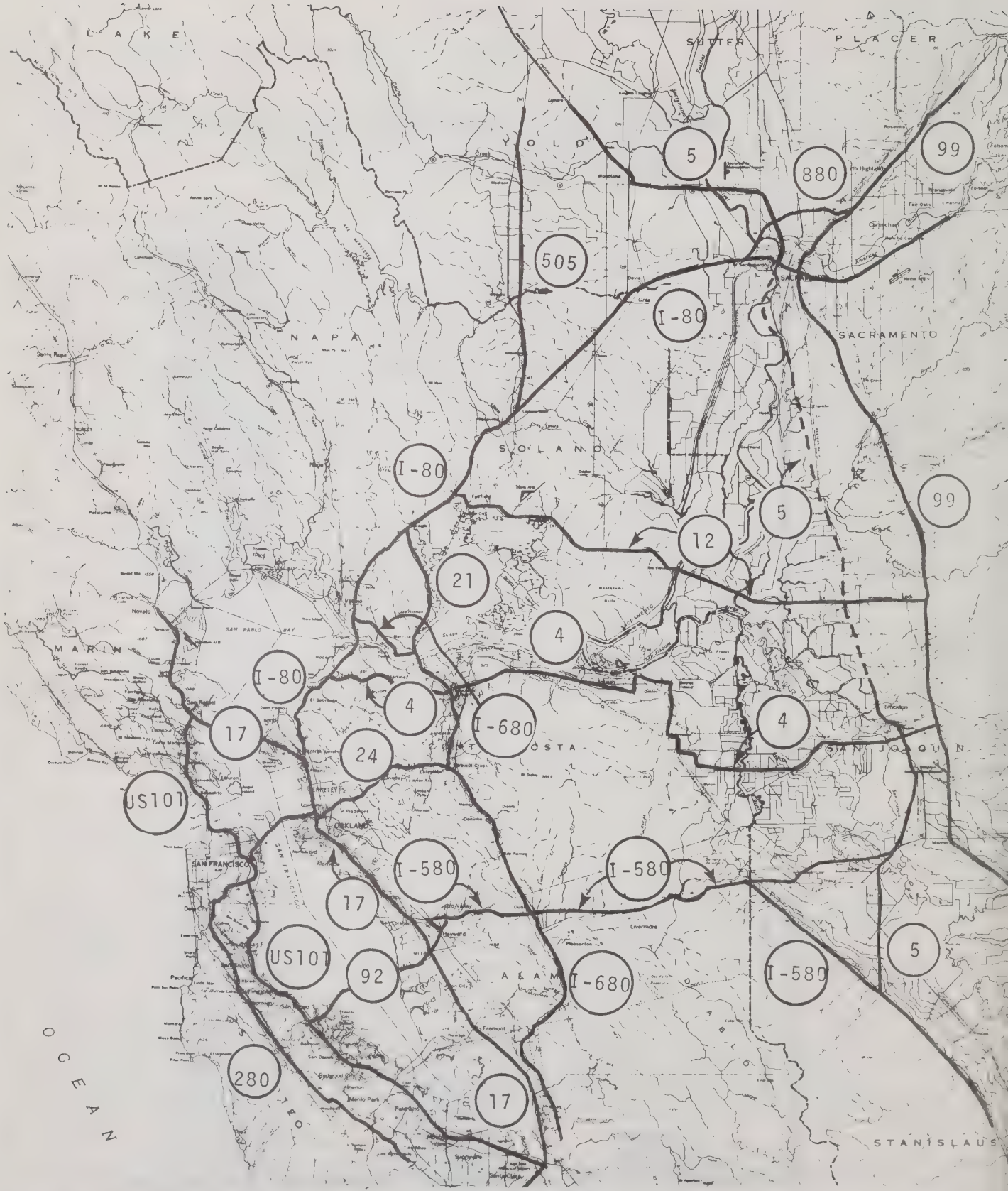
Between the Bay Area and Stockton, I-580, the major highway has a minimum of two lanes directional. Current upgrading will provide three lanes directional west to Livermore. Route 4 is also being upgraded in pieces. Right-of-way is planned for potential BART extensions on both 580 and 4.

Figure 23

EXISTING TOTAL TWO-WAY MOVEMENTS PER YEAR

BETWEEN BAY AREA AND SACRAMENTO





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24

MAJOR INTERCITY HIGHWAY ROUTES

AMV	
DRA	
EDAW	
KE	

69

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SACRAMENTO-STOCKTON-SAN FRANCISCO BAY AREA-CORRIDOR STUDY

25

NUMBER OF HIGHWAY LANES

AMV	
DRA	
EDAW	
KE	

70

Southern Pacific, Western Pacific and Santa Fe freight lines to some degree parallel these highways.

Between Stockton and Sacramento, Route 99 is the major highway facility with a minimum of 4 lanes directional over its length. The section of Route 5 between Sacramento and Stockton has been designed, and will soon be under construction. There are no significant parallel highway routes. Western Pacific, Southern Pacific and Central California Traction all own parallel railroad rights-of-way.

Between the North and South Bay there are a variety of major highway and railroad rights-of-way. These have not received major attention during this phase.

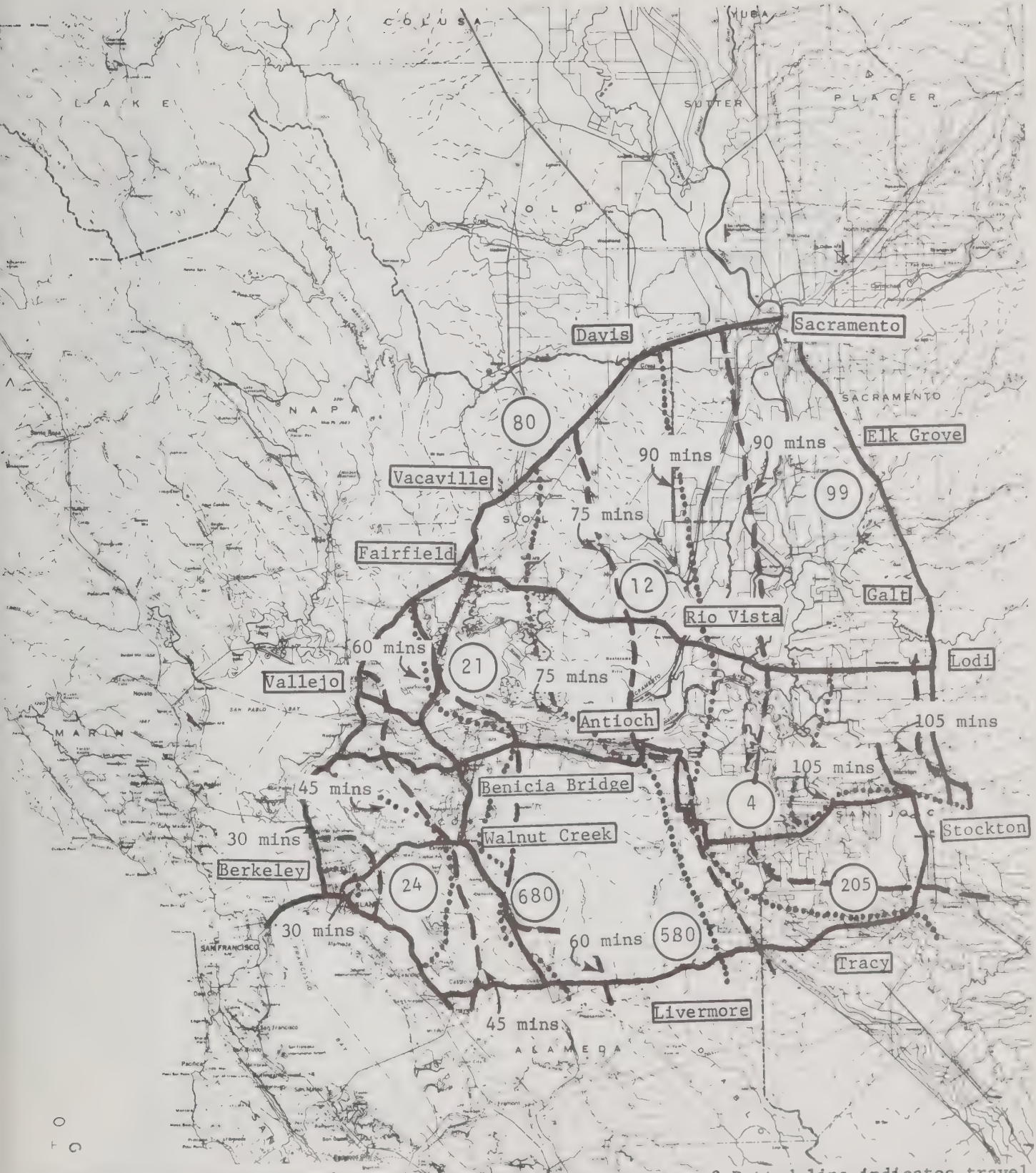
There are the considerable constraints to adding to the major routes through widening. The numbers of bridges and overpasses are indicated, showing substantial reconstruction implied in any sigificant widening program. On I-80, for example, 65 structures might be involved in achieving an 8-lane expressway between Berkeley and Sacramento. Major reconstruction would be similarly required for significant continuous upgradings on the other interstate routes.

Use of medians and shoulders for automobile or other mode-related improvements requires additional investigation.

The combination of traffic volume and available facility renders a level-of-service. While this varies considerably with daily, weekly and seasonal patterns (see paragraph below), the major congestion is experienced at rush hours in and out of the major cities when this coincides with peak recreation travel times. Figure 26 illustrates that during a normal week day, off-peak travel times at present are limited mainly by the speed limit. Peak period travelers for trips entering or leaving a metropolitan center during rush hour get caught in the commuting congestion. This overlap of inter and intracity travel and the competition for facilities is an important issue in this study.

The daily, weekly and seasonal trip-making patterns are illustrated by examples from I-80 in figures 27 through 29. There are two major flow patterns. The first illustrates the normal daily morning and afternoon week-day rush hour travel (dashed line). The second illustrates the Friday night, Saturday morning and Sunday afternoon traffic associated primarily with recreation trips. This latter pattern also has a seasonal variation, reaching a maximum in August and a minimum in January.

This travel can be translated into traffic volumes on highways. Figure 29 shows traffic volumes for 1971 and 1966 (in parentheses) on the major intercity facilities. Shown are the peak hour and average daily traffic during the peak and average months. The major flows occur where urban and interurban traffic overlap, on I-80 near the Bay Bridge and Route 99 near downtown Sacramento.



1 Dashed line indicates travel time (minutes) to C.B.D.-S.F. during A.M. peak hour traffic.

2 Dotted line indicates travel time (minutes) from C.B.D.-S.F. during P.M. peak hour traffic.

SSBACS

SACRAMENTO-STOCKTON-SAN FRANCISCO BAY AREA-CORRIDOR STUDY

26

TRAVEL STUDY TIME

AMV
DRA
EDAW
KE

72

figure 27

I 80 DAVIS WESTBOUND MARCH 1972

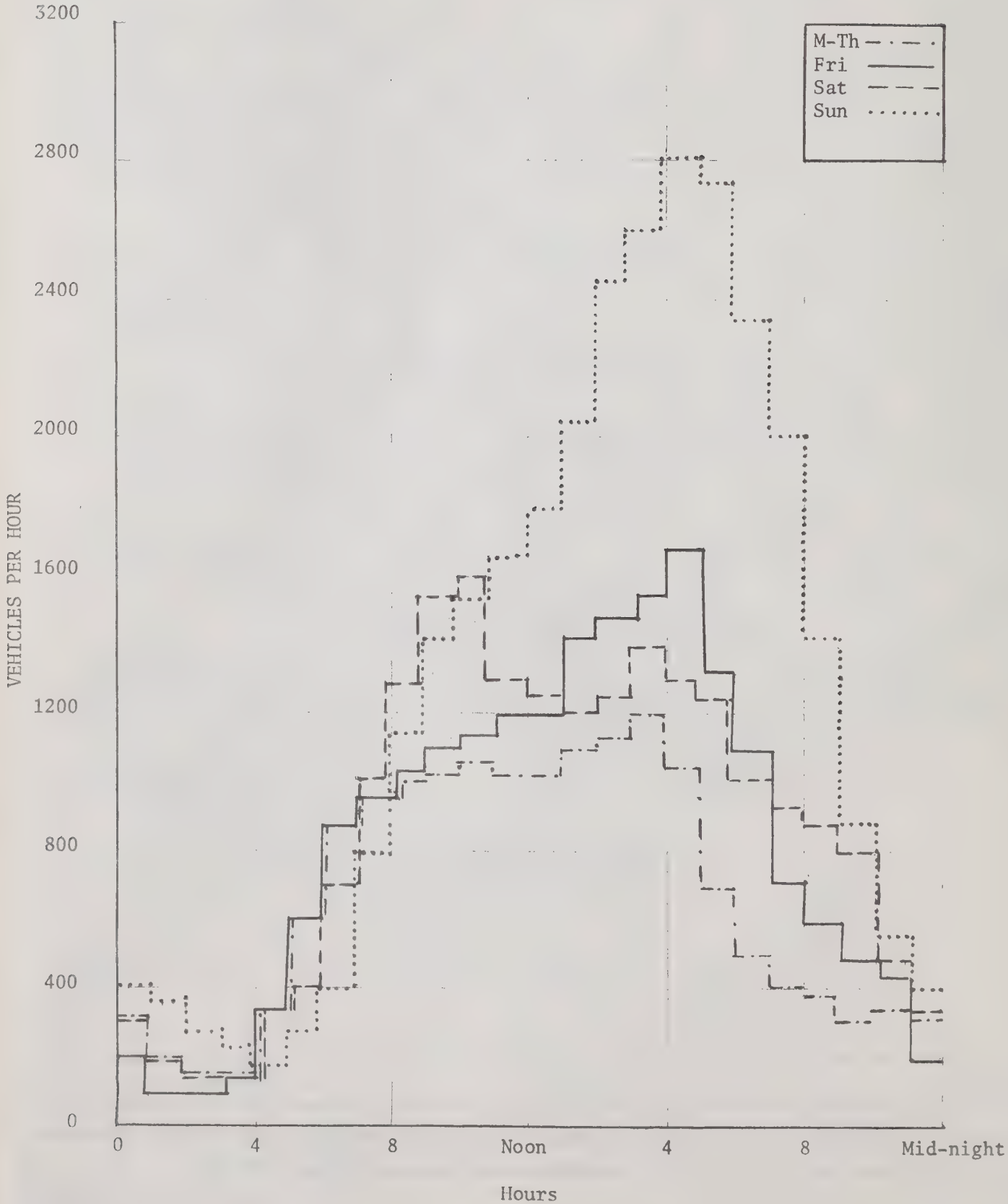
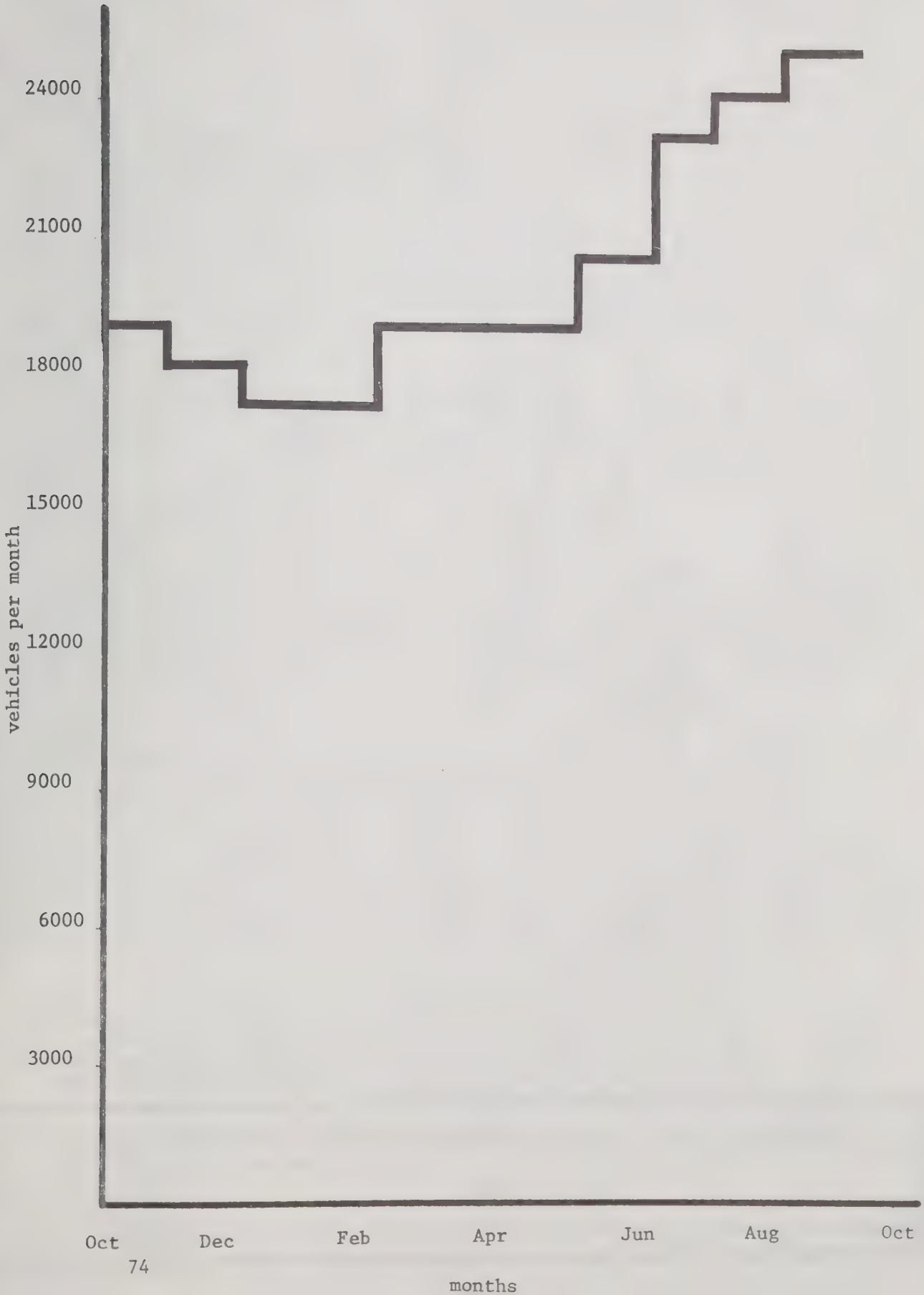
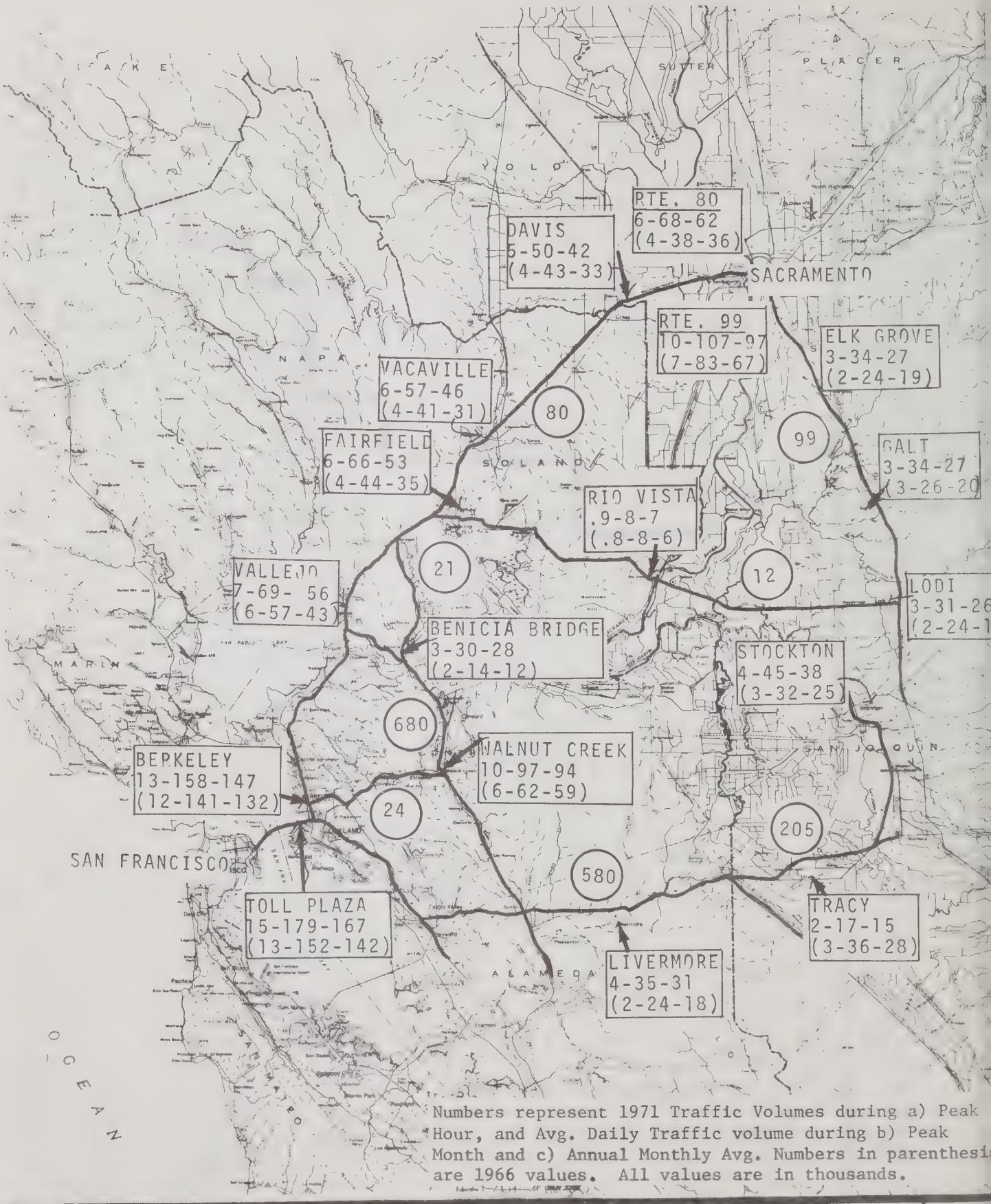


figure 28

I 80 DAVIS WESTBOUND OCT 1971--OCT 1972





Numbers represent 1971 Traffic Volumes during a) Peak Hour, and Avg. Daily Traffic volume during b) Peak Month and c) Annual Monthly Avg. Numbers in parenthesi are 1966 values. All values are in thousands.

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SACRAMENTO·STOCKTON·SAN FRANCISCO BAY AREA·CORRIDOR STUDY

29

TRAFFIC VOLUMES

AMV	
DRA	
EDAW	
KE	

75

The peak hour traffic between the major cities has not yet reached serious proportions, but the variance in daily traffic from the average to the peak month indicates a substantial and growing seasonality particularly on I-80.

The automobile travel picture at present suggests two distinct growing, but related problems. First, the typical urban commute patterns give rise to rush hour congestion. Without enormous transit investments beyond those envisaged by any study to date, this problem can be expected to continue, and in many areas worsen.

Secondly, intercity travel is growing. Components of this travel overlaps with commute travel and suffer in its congestion. Other components of the intercity and long-distance travel, primarily recreation travel, have special "rush hour patterns"--Friday nights, Saturday morning and Sunday night. The times this "rush hour" occurs are fewer in number, perhaps 30 weekends per year.

Thus each type of travel has its own patterns and will be experiencing growing congestion. There is some overlap and competition for facilities. However, the trip types, and time patterns are distinct. Each deserves attention. The intercity problem is the main focus of this study.

VI.B. Bus

Bus travel performance is limited by highway performance in "free market" conditions where no special provisions for buses are made. Intercity bus travel in the Study Region is offered primarily by Greyhound and Trailways. Greyhound offers San Francisco-Sacramento service hourly via Route I-80 at a scheduled time of one and one-half hours. One-stop service (Richmond) is offered from Oakland nine times per day ($4.57). Local service is also offered.

State PUC figures showed 480,000 San Francisco (Oakland) Sacramento bus riders in 1971, down 40,000 from 1966. Greyhound service does not interface with BART. These trends are shown in figure 30.

Service to Stockton from San Francisco is also offered by Greyhound eight times per day, but with only one non-stop trip with the trip requiring one hour and fifty minutes. Between Sacramento and Stockton, Trailways offers three trips per day for the one-hour trip and Greyhound offers 10 trips per day including limited non-stop service.

VI.C. Railroad

The railroad rights-of-way have been inventoried and basic data is indicated on figure 31. Most of the railroad routes are single track with intermittent passing tracks and off-loading turn-outs. There are few grade-separations outside of densely urbanized areas. Most rights-of-way of importance are

All the "live" tracks between the Bay Area, Sacramento and Stockton are used for freight exclusively, with the exception of the double tracked Southern Pacific route between Oakland and Sacramento (and byond through Truckee). Several routes have heaby freight usage and others carry largely seasonal traffic in response to local crop cycles. The Sacramento Northern route between Collinsville and Sacramento still carries season freight traffic.

Significant data on existing rail traffic, railroad plans and other physical characteristics information and relating to their possible dual use for passenger traffic will be developed early in the second cycle.

Existing rail passenger service in the study area is a by-product of AMTRAK's thrice-weekly service Oakland to Chicago (via Sacramento) and Seattle to Los Angeles (via Davis and Oakland). Service from Oakland takes one hour and fifty minutes and costs $4.50. Southern Pacific Railroad, the major railroad in the area (along with the Atcheson, Topeka and Santa Fe and the Sacramento Northern) has shown little interest in passenger service which is an uneconomic operation given the technology and institutional structure of the industry. On the contrary, they have indicated an interest in dropping the remaining commuter operations as they are required to maintain (San Francisco-San Jose) and concentrate instead on the profitable freight business.

VI.D. Air

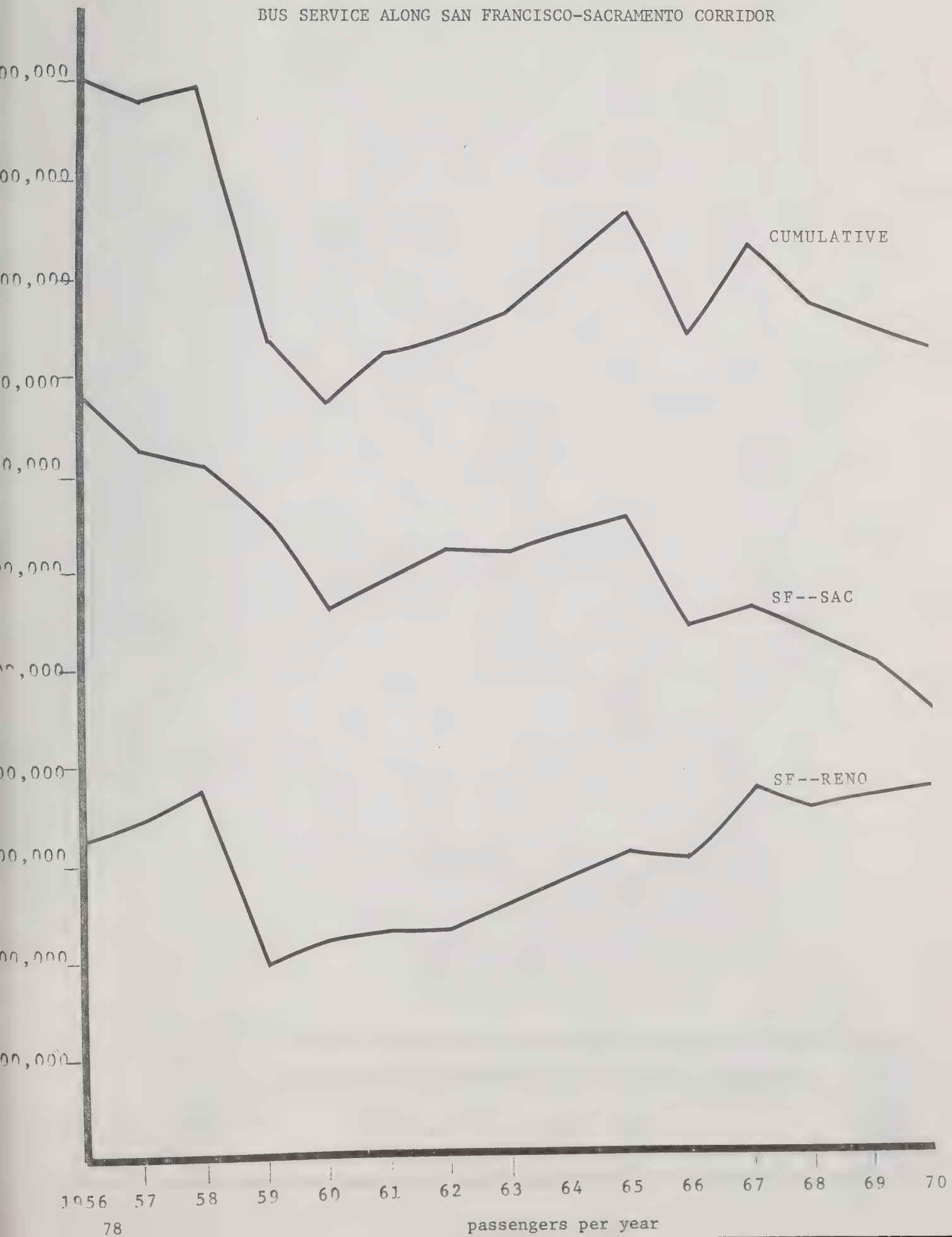
San Francisco and Oakland to Sacramento or Stockton service is currently offered by three airlines on a variety of schedules. PSA San Francisco-Sacramento service, for example, is five flights daily on a twenty-five minute schedule excluding terminal time. One Oakland to Sacramento flight is offered. The fare is $8.00 Statewide air traffic studies show 80,000 air travelers from San Francisco to Sacramento per year. Air travel to Stockton from San Francisco was 5,000 per year in 1971.

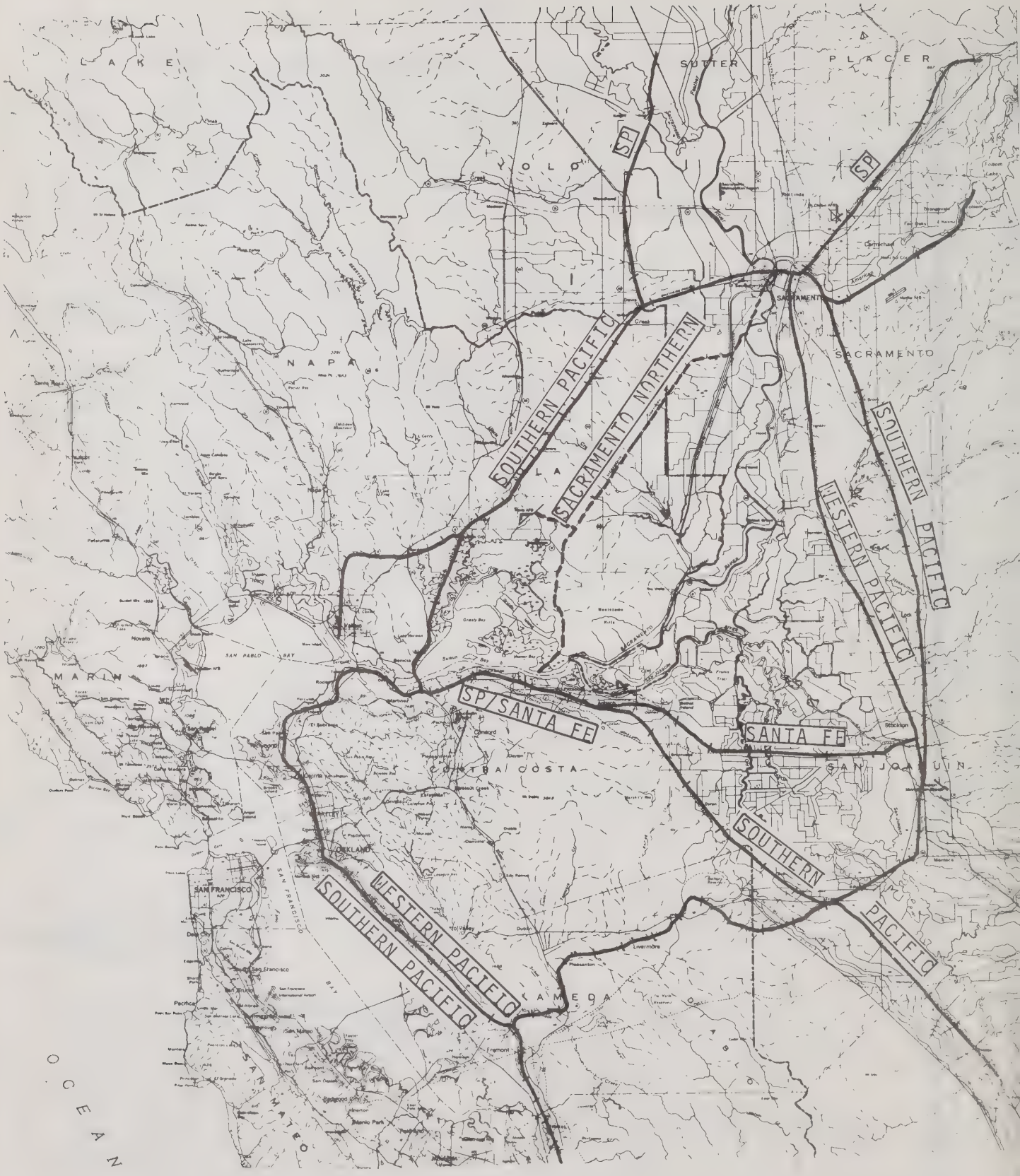
Current air travel facilities in the study region consist of the airports and airspace resources. These have recently received major attention in studies by ABAG and a continuing effort by the State Department of Aeronautics.

The ABAG Regional Airport Systems Study predicted that commercial air passenger travel will increase from 28 million annual passengers in 1975 to 72 million in 1985. Private aircraft (general aviation) is predicted to double, rising from about 5700 planes in 1975 to 9900 in 1985.

ABAG predicted that the five major airports within the study corridor can, with only minor additions handle the 1985 anticipated travel--distributed as follows:

figure 30


BUS SERVICE ALONG SAN FRANCISCO-SACRAMENTO CORRIDOR
CUMULATIVE
SF--SAC
SF--RENO
1956
57
58
59
60
61
62
63
64
65
66
67
68
69
70
78
passengers per year



SSBACS

SACRAMENTO·STOCKTON·SAN FRANCISCO BAY AREA·CORRIDOR STUDY			31
MAJOR INTERCITY RAILROAD ROUTES	AMV		79
	DRA		
	EDAW		
	KE		

- San Francisco--31 million annual passengers
- Oakland--24 million annual passengers--assuming an increasingly important role
- San Jose--10 million annual passengers--limted by environmental concerns
- Hamilton Air Force Base--1 million annual passengers--limited by sponsoring counties
- Travis Air Force Base--converted to joint civilian-military use--6 million air passengers--serving local needs with possible future a fourth major jetport

These capacities reflect a variety of policy compromises relating to environmental and community impact, access and distributional assumptions. No major STOL system is assumed to be in operation. BART extensions are assumed to San Francisco and Oakland airports but no high speed grand access to Travis has been studied. The operations at Travis airport have deliberately been held at a level thought not to compete with Sacramento Metropolitan Airport.

The current Statewide Master Plan for Aviation makes some different assumptions in their forecasts, particularly in respect to distribution. These do not become important however, until beyond the 1985 time frame, when the Statewide Study indicates the need for increased capacity in San Jose and Marin County. In addition, the Statewide Study shows the following air passenger traffic for Sacramento Metropolitan and Stockton Airports in 1985--5.59 million and 352,000.

The above projections and their implication for intercity mode choice will be investigated during the next phase.

Urban Transit--The major urban transit systems in the study area, BART and the local bus systems operated by Counties and Cities are currently being inventoried. Emphasis is on their feeder/distribution capabilities to serve possible intercity transit improvements. Since only BART currently operates urban transit on fixed guideway it has received special attention in this phase. In addition, BART, MTC, Counties and Communities are currently considering extensions in an eastward direction which then become obvious points-of-departure for transit connections to Sacramento and Stockton. Figure includes an indication of options currently under technical study for extensions in the Pittsburg-Antioch and Livermore-Pleasanton directions.

The study for the Pittsburg-Antioch BART extension is currently considering four routes from Concord:

- via the Sacramento Northern right-of-way to state highway 4, located in the median of a widened state highway 4 to Antioch.

- o via Port Chicago, using the Sacramento Northern then via a railroad right-of-way through West Pittsburg and Antioch to Brentwood.

- o to a Pittsburgh-Antioch terminal via an "overland' route crossing the hills in the Ygnacio Valley area.

- o combination of the above

The major issues under review concern whether to locate the major impacts in urbanized areas for their potential employment and commercial impacts in the northern areas or whether to plan the extensions to guide new development in the areas south of Route 4. The location of the terminal in either case would influence the viability for further extension to Sacramento or Stockton.

The Livermore-Pleasanton BART extension study is currently considering three possible routes:

- o from Castro Valley in the median of a widened I-580 via Dublin Canyon.

- o from Walnut Creek in the median of a widened I-680 via San Ramon Canyon.

- o from Union City via Niles Canyon.

The major issue at present concerns the route and pattern of development that might be encouraged by each of the extensions. The location of the terminal would affect its viability for possible further extension to Stockton.

The desirability of these extensions and their possible routings and terminals will be affected by their potential as points of departure for further extension or transfer serving intercity travel. This study will maintain contact with the BART extension studies.

VI.E. Summary

While section VI discusses some of the operating characteristics of the existing systems (how they are presently used) three points can be observed relative to the physical characteristics of the existing transportation infrastructure.

First, further analysis of the physical characteristics is concentrating on the possibilities of either increasing the use of an existing transportation right-of-way with the mode for which it was originally intended through either increased efficiency or physical expansion. The use of a right-of-way or movement channel constructed for one mode (say general purpose automobile) for more than one mode by addition of guideway (such

as a busway) or conversion of part of the right-of-way for use by another mode is also under consideration. The conversion of rights-of-way from use by one mode to use by another is also being considered. An example of this would be conversion of a rail right-of-way in the long term into a Tracked Levitated Vehicle (TLV) guideway. Finally, dual use or conversion of terminals is an issue such as the use of Travis Air Force Base as the fourth commercial jetport serving the Bay Area.

Second, the existence of modal interchanges is also of concern. This includes operational as well as physical concerns. Short-run issues include the ease of transfer from BART to express bus or from express bus to local bus to expand the service area of the bus and transit access to major airports. Park/ride facilities at all major non-downtown transit and/or rail stops is also a key short-run issue.

Third, network relationships, both highway and transit are a component of the systems aspect of infrastructure interface--not only through the question of car and bus feeders to transit, but also through the question of the relationship between intercity-oriented highways and the urban arterial and local street systems to which they must be joined in such a fashion as to minimize their negative impact and provide the maximum collection and distribution service.

Goods Movement--No work has been done on goods movement during this cycle. Goods movement considerations will enter the evaluation largely through consideration of the freight capabilities of improvement alternative primarily aimed at serving passenger travel.

VII. TRANSPORTATION IMPROVEMENT PROGRAMS AND NEW TECHNOLOGY

In keeping with the cyclical approach outlined in the introduction, the development and evaluation of transportation improvement programs will occur in each phase successively concentrated on more promising alternatives. This process includes an inventory of existing transportation facilities, an analysis of existing travel, the development of possible improvement programs, the forecast of travel for those programs and the evaluation of the improvement programs.

As indicated in the introduction, the improvement programs, conceived within the framework of overall corridor management, are being developed as part of a transportation system which is already multimodal but to which substantial improvements may be made to meet a variety of transport and non-transport objectives.

Each improvement program receiving final evaluation in the last phase will likely be a mixed program of actions to coordinate and resolve the potentials of the various modes serving intracity travelers. The programs will include short and long-run components with a staging strategy. The programs will, in all liklihood consist of operational changes to existing modes as well as possible installation of a new technology.

Special attention is being given to transit solutions, ranging from bus to STOL to high speed TACV. A clear mandate of this study is to investigate the feasibility of alternatives to the automobile which, while it will probably remain the predominate mode in the region--may not continue to dominate all travel purposes. The search is for advantages offered by different transit solutions--economic, environmental, social and developmental.

The first step in the search for alternatives is a broad review of available transportation technologies. These technologies, along with routes, terminals, fares, schedules, operation, make up components of improvement programs. The technology review has deliberately been undertaken at a high level of generality to permit a quick review of possibilities prior to a narrowing down to the promising alternatives.

VII.A. Base Line Technology Evaluation

Transportation improvement programs are composed of several transportation components. Each component is made up of a technology, mode, route, and operational configuration. In this preliminary analysis only relatively simple base line components are being evaluated for purposes of maximum contrast in this initial examination. The analysis of base line technologies which comprise the components is inclusive, but schematic.

Eight basic transportation technologies have been selective for comparison across a range of service, cost and impact criteria. For certain criteria, each technology is analyzed via a prototype. The 8 technologies are:

- o conventional auto--represented by a full size 1972 automobile
- o bus--represented by a standard GM "scenicruiser"
- o conventional rail--represented by the Tokkaido line in Japan
- o rapid transit--represented by BART
- o high speed ground transportation (tracked levitated vehicle)--represented by the French Aerotrain
- o conventional air--represented by the B-757 and the DC-8
- o short-take-off-and-landing (quiet-short haul)--represented by the DHC-7
- o very-short-take-off-and-landing (VTOL)--represented by the B107-11 helicopter

Hybrid technologies such as dual-mode busway and advanced passenger train are not separately indicated on the chart.

The discussion below explains each criteria and comments on significant findings as indicated in figure 32..

Figure 32

CHART I - MAJOR CHARACTERISTICS OF SOME BASE LINE (PROTOTYPE) TECHNOLOGIES

	CONVENTIONAL AUTO	BUS	CONVENTIONAL RAIL	RAPID TRANSIT	HIGH SPEED GROUND TRANSPORTATION	CONVENTIONAL AIR	STOL	VTOL
1 DEVELOPMENT STATUS	OPERATIONAL	EXISTING-OPERATIONAL NEW-MODEL STAGE	OPERATIONAL	OPERATIONAL	MODEL	OPERATIONAL	LARGE-MODEL SMALL-OPERATIONAL	OPERATIONAL
2 TIME TO IMPLEMENT FOLLOWING SELECTION (INCLUDE DEVELOPMENT)	N.A.	N.A.	3 YEARS	5 YEARS	5 YEARS (9 YEARS)	N.A.	7 YEARS (10 YEARS)	N.A.
DEVELOPMENT COSTS (TO BE PAID CALIFORNIA AGENCY)	NONE	EXISTING - NONE NOW - UMTA	NONE	NONE	DOT FUNDED	NONE	FUNDED (PRIVATE)	FUNDED (PRIVATE)
IMPACT ON CALIFORNIA ECONOMY (CONSTRUCTION CONTRACTS EQUIPMENT SUPPLY)	+ (IF MORE ROADS) - (IF NO MORE ROADS)	0	+ NEW TRACKAGE AND TERMINALS	+ NEW SYSTEM AND EQUIPMENT	+ NEW SYSTEM AND EQUIPMENT	~+ NEW EQUIPMENT AND TERMINALS	+ NEW TERMINALS AND MAINTENANCE FACILITIES	+ NEW TERMINALS AND MAINTENANCE FACILITIES
3 HOURLY CAPACITY IN ONE DIRECTION	FREEWAY-1000 V/L/HR AT 50 MPH ON A 70 MPH FREEWAY AT 2 PAS/VEH.= 2000 PAS/L/HR (L=LANE)	400 BUSES/L/HR AT 50 PAS/BUS =20,000 PAS/L/HR (VARIES)	1-10 CAR TRAIN/HR = 820 PAS/HR 4-10 CAR TRAIN/HR =3280 PAS/HR	1-10 CAR TRAIN/HR =720 PAS/HR 4-10 CAR TRAIN/HR = 2880 PAS/HR	1 VEHICLE/HOUR = 100 PAS/HR 4 VEHICLES/HR = 400 PAS/HR	1 FLIGHT/HOUR = 125 PAS/HR 4 FLIGHTS/HOUR = 500 PAS/HR	1 FLIGHT/HOUR = 48 PAS/HR 4 FLIGHTS/HR = 192 PAS/HR	1 FLIGHT/HOUR = 25 PAS/HR 4 FLIGHTS/HR = 100 PAS/HR
VEHICLE CAPACITY (SEATED)	5 (AVERAGE)	45-53	82 (TOKAIDO RR)	72 (BART)	100 (AEROTRAIN)	125 (B-737)	48 (DHC-7)	25 (B 107-11)
VEHICLE LIFE CYCLE	7 YEARS	12 YEARS	20 YEARS	20 YEARS	20 YEARS	12 YEARS	12 YEARS	10 YEARS
NUMBER OF VEHICLES REQUIRED TO MEET THE DEMAND OF: . 500 PASSENGERS/HR . 2000 PASSENGERS/HR	. 250 .1000 2 PAS/CAR	.10 .40	. 7 .25	. 7 .28 (72 PAS. VEHICLES)	. 5 .20	. 4 .16	.10 .41	.20 .80
NORMAL MAXIMUM OPERATING SPEED (AVERAGE SPEED) (DIST?TIME FOR RICHMOND/SACTO-3 STOPS	70 MPH (62 MPH)	70 MPH (59 MPH)	100 MPH (78 MPH) (MAX SPD DEPENDS UPON TRACK CONDITIONS)	80 MPH (68 MPH)	200 MPH (100 MPH)	370 MPH MAX SPEED LOW DUE TO SHORT TRAVEL DISTANCE	276 MPH (OHC-7)	160 MPH (B 107-11)

OPERATING COSTS/ VEH. MI. (DOLLARS) (PER PASSENGER MI. WITH 50% OCCUPANCY) 1	0.10 (WITH NO DEPRECIATION) (0.04)	0.92 (1.84¢/SEAT MILE-IPTS) (0.04)	1.64 (2¢ PER PAS. MILE-IPTS) (0.04)	1.16 (NNTS) (0.03)	5.00 (AEROTRAIN WITH TURBINE - NNTS) (0.10)	7.50 (6¢ PER SEAT MILE NO MILE TRIP IPTS) (0.12)	2.40 (5¢ PER SEAT MILE IPTS) (0.10)	3.25 (B107-11 NNTS) (0.26
ENERGY (BTU)/VEH. MI. [BTU/PAS MI.(50% OCCUPANCY)]	10,100 (13.5 MPG) [4,050]	27,200 (5 MPG) [1,090]	77,000 (TRI) [1,870]	54,000 [1,510]	272,000 (2 gpm) [5,450]	525,000 (DC-8 TRI) [8,420]	290,000 (TRI) [12,100]	330,000 (TRI) [26,400]
OFFLINE CAPABILITY	YES (MAXIMUM FLEXIBILITY)	YES (SOMEWHAT RESTRICTED FLEXIBILITY)	NO	NO	NO	YES (LIMITED BY EXISTING TERMINALS)	YES (LIMITED BY EXISTING TERMINALS)	YES (LIMITED BY EXISTING TERMINALS)
SHARED ROW POSSIBILITIES	ONLY WITH EXISTING ROUTES	WITH EXISTING AUTO ROUTES	WOULD SHARE EXISTING TRACKS WHERE POSSIBLE	COULD SHARE HIGHWAY MEDIAN OR RAILROAD NON-TRACK ROW	COULD SHARE HIGHWAY OR RAILROAD ROW	MUST SHARE TERMINAL FACILITIES	COULD SHARE CONVENTIONAL AIRPORT ROW	COULD SHARE CONVENTIONAL AIRPORT ROW
INVESTMENT RISK FACTOR	LOW	LOW	MODERATE	MODERATE-TO-HIGH	HIGH	LOW	MODERATE	LOW
CONVENIENCE (COMPARED WITH CAR) 1 TRIP LENGTH (TIME) ADHERANCE TO SCHEDULE	≃ ≃	SLOWER SAME	FASTER BETTER (SLIGHTLY)	FASTER BETTER	FASTER BETTER	(ASSUME NO FOG) FASTER BETTER	(ASSUME NO FOG) FASTER BETTER	(ASSUME NO FOG) FASTER BETTER
MAGNITUDE OF SUPPORT SYSTEMS REQUIRED (RELATIVE TO THAT REQUIRED FOR A BUS SYSTEM) 1	NONE REQUIRED	~	SAME MAGNITUDE	SAME MAGNITUDE	SAME MAGNITUDE (WITH TERMINAL IN A CENTRAL LOCATION) ADDITIONAL BUS OR BART TYPE SYSTEM IF TERMINAL NOT CENTRAL	ADDITIONAL BUS OR BART TYPE SUPPLEMENTARY SYSTEM	ADDITIONAL BUS OR BART TYPE SYSTEM ONLY WHEN CONVENTIONAL AIRPORT FACILITIES USED	ADDITIONAL BUS OR BART TYPE SYSTEM ONLY WHEN CONVENTIONAL AIRPORT FACILITIES USED
NEW TERMINAL REQUIREMENTS	NONE	MINIMAL	IMPROVED PASSENGER TERMINALS	ALL STOPS	ALL STOPS	NONE (JUST IMPROVEMENTS AT EXISTING AIRPORTS)	ONLY WHERE EXISTING TERM. CANNOT BE SHARED	ONLY WHERE EXISTING TERM. CANNOT BE SHARED
COMFORT (COMPARED WITH CAR) -PHYSICAL -MENTAL	0 0	- 0	+ +	+ +	+ +	0 +	0 +	0 0
RECREATION TRIP UTILITY (DESTINATION FLEXIBILITY) 3	HIGH	HIGH-TO-MODERATE	MODERATE	LOW	LOW	LOW	MODERATE	MODERATE

•ENVIRONMENTAL FACTORS 3 •NOISE •AIR POLLUTION 1) CURRENT STDS. 2) W/IMPROVED ROADS •AESTHETIC IMPACT	•HIGH 1)•HIGH 2)•MODERATE •HIGH	•HIGH 1)•HIGH 2) MODERATE •HIGH	•HIGH 1)•MODERATE 2)•LOW •MODERATE	•MODERATE 1)•LOW •MODERATE	•LOW 2)•LOW •MODERATE	•HIGH 1)•HIGH 2)•MODERATE •LOW	•LOW •HIGH •LOW	•MODERATE •HIGH •LOW
GEOMETRIC CRITERIA AT MAXIMUM OPERATING SPEED •MINIMUM CURVE RADIUS(FT) •MIN. VERTICAL CURVE LENGTH(FT)	•1,500 (SE=0.10 FT/FT COEFF. OF FRICT = 0.12) •1,300 (CREST AT ΔG=5% S.D.=600')	•1,500 •1,300	•5,700 •10,000 (CREST AT ΔG=5%)	•3,400 (WITH 6" S.E.) •875 (CREST AT ΔG=5%)	•26,400 AT 200 MPH 6,600 AT 100 MPH 4,600 AT 70 MPH •52,800 AT 200 MPH (0.05 g)	N.A.	N.A.	N.A.
MINIMUM DISTANCE CENTER TO CENTER (TWO WAY DOUBLE TRACK (LANE) SPACING (FT)	42 (MEDIAN) 20 (BARRIER)	42 (MEDIAN) 20 (BARRIER)	15	14	15 (AEROTRAIN)	N.A.	N.A.	N.A.
BAGGAGE CAPABILITY •SELF CARRIED •CHECKED	•GOOD •N.A.	•FAIR •GOOD	•FAIR •MODERATE	•FAIR •LOW	•FAIR •LOW	•FAIR •GOOD	•FAIR •GOOD	•FAIR •GOOD
GOODS MOVEMENT CAPABILITY (AS DESIGNED) 3	POOR	FAIR	EXCELLENT	POOR	POOR	EXCELLENT	FAIR	POOR
RELIABILITY IN TERMS OF •EQUIPMENT (MTBF) •ALL WEATHER COND. •SERVICE	•HIGH •MODERATE •MODERATE	•HIGH •MODERATE •MODERATE	•HIGH •HIGH •MODERATE	•HIGH •HIGH •HIGH	•HIGH •HIGH •HIGH	•HIGH •MODERATE •HIGH	•HIGH •MODERATE •HIGH	•HIGH •MODERATE •HIGH
•CAPITAL COSTS •FIXED FACILITIES •VEHICLES (DOLLARS) •WAY (LOW 0-30,000;MED. 30-500,000;HIGH 500,000)	•N.A. •LOW (2-6,000) •HIGH	•MODERATE •MODERATE (55,000) •HIGH	•HIGH •MODERATE (200,000) •HIGH	•HIGH •MODERATE (200-300,000) •HIGH	•HIGH •HIGH (600,000) AEROTRAIN •VERY HIGH	•HIGH •HIGH (8,000,000) •N.A. B707	•HIGH •HIGH (1,840,000) •N.A. DHC-7	•MODERATE •HIGH (750,000) •N.A. B107-11

KEY

1 IMPORTANT CRITIERION IN DETAILED SYSTEM EVALUATION
2 IMPORTANT CRITERION IN SYSTEM COMPARISONS
3 BOTH OF THE ABOVE

ABBREVIATIONS

NNTS-NEW AND NOVEL TRANSPORTATION SYSTEMS
IPTS-INTERCITY PASSENGER TRANSPORT STUDY
IRI-TRANSPORTATION RESEARCH INSTITUTE
SE-SUPER ELEVATION

Development Status -- indicates how close a particular system is to being put into practical application. A system is operational if there are examples of such a system currently serving the public. A system is in the model stage of development if prototypes are still being tested and examples of such a system are not yet being used as a means of public transportation.

Time to Implement Following Selection -- specifies how much time must be spent before a particular system will be ready to serve the public. This time includes system construction and system testing. Development time is the additional time needed to refine models to the point that the system is ready for a revenue installation.

Development Costs -- indicates for systems that require further development who, if any, will fund such work.

Impact on California Economy -- indicates the economic effect each system will have on industry and business in California. Considered are resulting net employment change and net change in demand for in-state manufactured items.

+ positive impact-increased spending, new jobs, new businesses.

0 negligible impact - either positive effects would be offset by detrimental effects, or there would be no significant change from the status quo.

- a detrimental impact - loss of jobs, loss of patronage from existing businesses.

Hourly Capacity in One Direction -- indicates the number of passengers that can be transported by each type of system in one direction in one hour under the conditions noted. The calculations do not take into account system terminal conditions or capacities.

Vehicle Capacity (Seated) -- indicates the number of passengers that can be seated in a single vehicle in each system. The numbers come from representative vehicles of each system and reflect magnitudes, not specific limiting design criteria.

Vehicle Life Cycle -- is the number of years of service that can be expected from a vehicle before major rebuilding work or replacement must occur in order to avoid uneconomic operation or to upgrade passenger comfort and safety to an acceptable level.

Number of Vehicles Required to Meet the Demand of 500 Passengers/Hour and 2000 Passengers/Hour -- In all but the case of the automobile, it is assumed that the vehicles are filled to seated capacity.

Normal Maximum Operating Speed -- is the actual speed of systems currently operating, or is the design operating speed of proposed systems. The average speed is the average speed for a Richmond to Sacramento trip with three stops.

Operating Costs per Vehicle Mile -- this is an indication of how expensive it is to operate a vehicle typical of each system/per mile (with no occupancy assumptions). The cost per passenger mile normalizes the vehicle mile cost so that the cost to transport people is indicated. In the per-passenger-mile case, it is assumed that there is a 50% vehicle occupancy.

Energy (BTU) per Vehicle Mile -- represents energy consumption for vehicle propulsion per mile. In cases where the vehicle operates under electrical power, the amount of fuel burned in order to produce the needed electricity was estimated. In all cases the fuel consumed was converted directly to BTU's of energy. The BTU/vehicle mile normalizes the consumption figure in order to compare the systems on the basis energy required to move the same number of passengers. However, in the case of BART, the figure includes "system" energy requirements (stations, light, heat, escalators, etc.(without which it could not operate--only 40% of BART's energy requirements are related to propulsion).

Offline Capability -- answers the question of whether or not a system (vehicles of a system) can be used for purposes other than providing transportation along specific routes in the San Francisco-Sacramento corridor.

Shared Right of Way Possibilities -- indicates that potential there is for a system to use the ROW of existing transportation routes.

Investment Risk Factor -- is based on the following criteria: length of time similar systems have been in operation; amount of costly special purpose equipment needed; technological trends which have the potential of negating advantages of a particular system.

Convenience (Compared with Car) -- in terms of time this qualitatively indicates what savings over an automobile could be made with each system and how consistent this savings is.

Magnitude of Support Systems Required -- indicates that complementary or auxiliary systems are needed in order for the proposed system to be satisfactory to the public. A local bus system is used as a standard since it is required by all systems except the automobile. The magnitude reflects the ease of access/egress.

New Terminal Requirements -- indicates what new/special purpose terminals are needed for each type of system. In some cases where no new terminals are required, improvements of existing terminals are necessary.

Comfort (Compared with Car) -- Physical comfort is in terms of leg room and freedom to move around as well as quality of vehicle ride. Mental comfort is mainly a feeling of security.

+ greater comfort than car

0 same or comparable

- less comfortable.

Recreation Trip Utility -- is an indication of what uses each system has other than commuter/intercity transportation. It could also be viewed as endpoint flexibility or comfort and convenience to those carrying items normally not handled by commuters - skis, golf clubs and other recreation equipment. Low utility means that all advantages gained by taking that particular mode are offset by comfort, convenience and/or cost disadvantages. Certain modes (like BART) can be viewed as having urban recreation utility inconvenience for reaching urban attractions.

Environmental Factors --

Noise - all levels are tolerable at distances people would normally be from the vehicles. Only vehicle noise is considered. High indicates that if people were subjected to that level for extended periods of time it would become intolerable. Moderate indicates that the noise would be annoying over extended periods of time. Low indicates that the noise level would be acceptable.

Air Pollution - a high level indicates that the system is a major contributor to air pollution. Moderate indicates less pollution than the automobile, but still an unacceptable long-range level. Low indicates that the air pollution caused is about as low as possible under existing technologies for mass transit systems. PCD's are pollution control devices.

Aesthetic Appeal - Qualitatively indicates how harmoniously the system (including vehicles) lends itself to its surroundings, or how pleasing it is to view.

Geometric Criteria at Maximum Operating Speed - indicates what restrictions are imposed on system alignment in order for the vehicles to operate at maximum speed.

Minimum curve radius calculations assume that the curve occurs during zero grade change. For the High Speed Ground Transportation system, the radii were calculated on the basis of passenger discomfort occurring with lateral accelerations greater than 0.01 g and vertical accelerations greater than 0.05 g.

Minimum vertical curve length assumed a change of grade of 5% occurring at a summit or crest.

Minimum Distance Center to Center - is the distance from the centerline of the traveled way (or track) in one direction to the centerline of the traveled way (or track) in the opposite direction for single lanes in each direction.

Baggage Capability - indicates the relative amount of baggage that can conveniently accompany passengers on the various systems. For self-carried bags the automobile was used as the standard. For checked bags the bus was used as the standard.

Goods Movement Capability - indicates for the systems as they are currently proposed or designed how well they can move goods or freight without disruption to the primary purpose - passenger transport.

Reliability - in terms of equipment, high indicates infrequent mechanical or electrical problems serious enough to hamper system performance. (MTBF - mean time between failures).

All weather conditions indicates how well the system adheres to schedules during inclement weather. Is performance reduced by weather?

Service indicates how conveniently/comfortably people will consistently be served.

Capital Costs - Fixed facilities include terminals, maintenance buildings and control centers. The various systems are classed assuming minimum standards of passenger appeal and equipment features justified by system requirements.

Base line systems or concepts being examined are discussed in the following paragraphs.

VII.B. Automobile

The automobile is the dominant mode for intercity travel in the U. S. Even in the Northeast Corridor, intercity travel (less than 400 miles) was 74 % by car. In the shorter intercity trips > 150 miles automobile was even more dominant. Preliminary estimates indicate approximately 90 % of the Bay Area to Sacramento area travel is presently by car. For many trip purposes, the car provides a convenience and flexibility unmatched by public carriers, and in many cases at a comparable or lower cost per mile. This cost, travel time and convenience margin can decrease with distance and for certain purposes.

Costs of intercity automobile travel have been decreasing on a per-mile basis for over a decade. At the present time, a standard size new automobile costs from 12.8 - 13.8¢/mile over the first two years of its life if driven from 13,000 to 14,500 miles per year.[1] However, a reversal of this trend may accompany pollution control devices and increased fuel prices if engine modifications are not made. Speed of travel has also been increasing for intercity trips largely in response to the substantial investment in access-controlled highways. At the present time intercity average speeds are constrained primarily by urban congestion at the city ends (or middles) of such trips and a slight downward trend over time can be expected, barring major change in highway traffic control systems.

Major technological advances in automobiles are in the direction of greater safety and reduced emissions.

VII.C. Bus

Intercity bus travel continues to play an important role in the study region. While local bus service has suffered substantial declines nationwide, intercity bus travel continues to hold its own. Greyhound and Trailways maintain a large network of intercity services in California, including service in the Study Region. Other companies supply local services.

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[1] Including depreciation, insurance, taxs and out of pocket costs.

Modern intercity buses of the "scenicruiser" type are up to 40 feet long and 8 1/2 feet wide operating on three axles at speeds over 70 mph, sometimes powered by V-12 diesels of up to 400 horsepower. Passenger accommodations vary from 38 to 55 passengers and include air conditioning, reclining seats and a washroom.

Operating costs approach 2¢/seat mile about evenly divided between direct and indirect costs. The labor content of both is high such that technological advance has less impact on lowering costs. New technology is not expected to have a substantial impact on intercity buses. Gas turbine engines promise more power with less pollution and noise, but at a higher first cost and with greater fuel consumption. Buses, however, like automobiles have benefited from improvements in the highway network.

There is some tendency to increase bus capacity and hence reduce the labor cost per passenger mile. Multiple unit buses are used in Europe and are under development in the U. S. However, one of the main advantages of the 40 - 50 passenger "module" is that it permits operation in low cost "sections" ($65,000) with a flexibility that allows the operator to match the number of sections to the passenger demand.

VII.D. Dual-Mode Concept

Dual-mode is an automated highway system and is not discussed separately in the technological evaluation. It is a guideway-vehicle system which permits two modes of operation: automated (without a driver) on a special guideway and manual (with a driver) in ordinary mixed traffic.

The key aspect of the concept is the ability to operate both off and on the automated guideway. The advantages are the economic and performance capabilities of multiple occupancy, high-speed automation while retaining the flexibility to operate off-line on city streets, carrying out a feeder/distribution function. This dualism permits low density collection/distribution and high-speed operation in high density corridors with no need to transfer between vehicles. Capacities are projected to be 2-3 times as many vehicles per lane as achievable with manual operation. A further advantage in the long run is that both transit (multiple-occupancy) and private vehicles could share an automated guideway.

The guideway operation has all the beneficial characteristics of automated systems--high capacity on a narrow right-of-way, the possibility of using small scheduled vehicles. However, these potential advantages are predicted upon the achievement of high guideway capacity with fail-safe reliability, standardization of vehicles and public acceptance. Early systems will undoubtedly only be prototypes of the ultimate system, but the system is a natural extension of an exclusive busway and therefore has revolutionary appeal.

A variety of hardware systems are currently under development relating to dual-mode capability ranging from units to convert conventional automobiles to completely new systems. Many of the systems rely on an internal combustion or electric engine "off-line" but use guideway supplied power when running automatic. All systems use a guidance arm or special rails to power and control the vehicle while on automatic.

VII.E. Rail

Despite the long and cautious development of rail technology, federal regualtions and track conditions prohibit higher speed passenger service. For conventional rail, other technological limitations to speed are also found in power-to-weight ratios, suspension capabilities, adhesive capabilities track grade and curvature limitations as well as the need to share track with freight operations.

Most of these limitations have or can be overcome. Japanese, Metroliner and Turbotrain experience have shown the way.

Advanced passenger train development in the U.S., France and England continues and major hindrances at this time relate to costs, labor problems and the need for a demonstrated market outside the Northeast Corridor.

Power requirements have been met with electric or gas turbine propulsion and new suspensions have been developed which, along with welded rail, concrete ties, and the appropriate superelevation (or tilting suspension) can meet most speed requirements. In all cases it becomes desirable to eliminate all grade crossings and fence the track from human or animal trespass. With such improvement, metroliner-type service is a real technical possibility.

VII.F. Tracked-Levitated Vehicle (TLV)

The speed which can be achieved by ordinary trains is limited by the adhesion limits between steel wheels and steel rails. Higher speeds such as those achieved by the Japanese and more recent European high speed railroad experience indicates that the price of these speeds is an entirely new alignment designed to high tolerances. The costs involved and the desire to push above 200 mph suggest the feasibility of jumping to a new technology.

Tracked, levitated vehicles (TLV) eliminate physical contact with a track and instead ride on an air or magnetic cushion over and/or around a fixed guideway for lateral constraint. The air cushion which eliminates physical contact permits greater speeds, with no track vibration, lower rolling resistance and less noise. At the same time, however, elimination of wheels eliminates friction propulsion and requires air thrust (turbo-prop or turbo-jet) or linear induction motor where the guideway itself becomes one component of an "unwound" electric motor.

This type of propulsion requires a source of AC voltage which can either be supplied from a wayside line through a dynamic pickup system or be generated on board. For ecological reasons, the first case is preferred because it minimizes local pollution.

For the present, technical development is primarily concentrated on TACVs for high-speed transport of passengers at the 300mph spectrum. One primary disadvantage of air cushion support is the power required to maintain the air cushion. Also, switching of air-cushion vehicles from one track to another is awkward, so that a given vehicle may well be limited to a point-to-point shuttle service on a single route. Thus, its applicability to network operations appears severely limited.

At this time, the air cushion is an attractive and technically feasible means for supporting tracked vehicles between 300 and 500 mph. This range encompasses speeds above those at which traction wheels become impractical and below those at which aerodynamic resistance requires a prohibitive amount of power. Estimates of the limiting speed for steel traction-wheels (on steel rails) range from 200 to 300 mph. At the high end of the speed range, the power needed to overcome aerodynamic drag has increased, roughly, as the cube of air speed. This means that a 500-mph air-cushion vehicle will use 8 times the power of a 250-mph vehicle. Even though speed can be bought with power, other factors such as the ratio of payload to the weight of propulsion machinery will have to be considered.

One of the major concerns in air cushion development has been the efficient use of compressor power. Although a large cushion-ground separation is desirable, a large gap requires a high volume of air from the compressor. Many schemes have been suggested for limiting leakage while still providing adequate ground clearance.

Guideway-- The driving motivation behind the development of new guideway technology is cost. Tunneling is still a very high cost procedure and, because land acquisition can be expensive, the elevated guideway is considered the most economical in terms of land usage. Elevating the guideway also avoids the grade crossing safety problem.

In addition to structural problems, the major engineering concerns associated with TACV guideways include:

1. Methods for switching vehicles off the guideway. (For a high-speed, high-traffic-density line, this is a very significant problem.)

2. Methods for mounting and alignment-maintenance of the reaction rail (if a linear electric-motor is used for propulsion).

3. Methods for providing wayside power at high voltage and high current levels.

Propulsion--A TACV propulsion system must provide nontraction thrust. Aircraft propulsion systems would appear to be the most applicable; however, they are generally ruled out for reasons of noise and air pollution. The linear induction motor (LIM) is, at present, the most likely TACV thruster, and it is under extensive engineering development.

The source of electric power for the LIM primary on high-speed TACVs presents a very difficult engineering problem. One proposed design of a 300-mph TACV calls for a thrust of 10,000 lb. and 6 megawatts of power. Ideally, this power would be generated on board the vehicle; however, the only practical (at present) prime movers at this power level are fossil-fuel engines and their use is questionable because of noise and/or pollution problems. At present, the most feasible concept is to provide the energy from wayside power-rails through brush or noncontact collectors on the vehicle.

Magnetically Suspended Vehicles -- Magnetically suspended vehicles appear to be an attractive choice for speeds above those possible with rail systems. The idea of magnetic suspension, however, is still in the conceptual stage. Magnetically supported vehicles will probably share air cushion's switching difficulty, but they may be even less sensitive to guideway irregularities than air-cushion vehicles. Some proposed configurations have a levitation power requirement considerably less than that of air-cushion systems. The lift and propulsion elements of the vehicle could conceivably be combined into a single unit, simplifying vehicle design. A magnetically suspended vehicle would also be quieter.

VII.G. Air Transport Technology

Within the 20-year time frame encompassed by this Study, at least two generations of aircraft are corridor possibilities. The first, conventional take-off-and landing (CTOL) is represented by the type of aircraft currently serving the corridor which includes the smaller jets such as the Boeing 737 or the DC-9. These aircraft operate at cruise speeds between 350 - 450 mph and require conventional airport facilities, including 4,000 foot runways. Moving to larger aircraft such as the new wide-bacKed high capacity aircraft is not feasible while maintaining reasonable schedules.

Short-take-off and landing aircraft (STOL) are available now if the demand warrants. While the typical STOL plane can operate from fields

with runways of only 2,000 feet in length, it is slower and more expensive on a per passenger mile basis. The de Haviland DHC-7 is the classic STOL plane and improved versions with greater seating will become available in the mid-seventies.

The STOL concept would improve terminal access by locating them in developed urban areas. This is made possible by the aircraft's low noise and short runway requirements. Such "quiet short haul" aircraft have the additional advantage of diverting traffic from major airports which are becoming congested. The savings in access time can, for certain trips, greatly increase the attractiveness of the mode, particularly for the 80-100 mile flight distance where the access component of door-to-door travel time might be twice the in-flight time--as in the following example:

	STOL	CTOL
Access	20	30
Terminal Processing	20	30
Flight	35	25
Egress	20	20
Total trip time	95	115

One of the major problems facing STOL operations in the study region is identifying suitably close-in STOLport sites that are not environmentally objectionable which fit in with regional airspace considerations and which have good ground access. A variety of sites within the Bay Area have been studied including Concord, Livermore, Santa Rosa, Richmond, Pier 42, San Carlos, sites in the Bay, Oakland, and others. Conclusions that the STOL concept is economic and that major aircraft and STOL port investments are justified await more detailed forecasts.

VIII. IMPROVEMENT PROGRAM COMPONENTS

The combination of technology with its service capabilities and a route--a location of that service in space, is a component of a transportation improvement program. The section below develops a broad range of improvement components for the study region. It includes components divided into three classes:

- o Short-range -- Operations improvement requiring no new technology and only minor (if any) construction--consists generally of a reorganization of existing service and may sometimes require increased equipment.

- o Middle-range -- Minor to significant capital outlays required but using basically "off-the-shelf" technology.

- o Long-range -- Major capital outlays required including future developments of new transportation technology currently in the development or prototype stages.

While the range of components are divided into these groupings for purposes of discussion, it should be noted that a full improvement program alternative for the study region will include a staging strategy to tie short, middle, and long-range components together.

In the following discussion, no attempt is made to assess the costs or benefits of the improvement components. This is the function of the evaluation process, the first stage of which is described in Section

VIII.A. Short Range--Auto Operations Improvements

There are a variety of actions which could be taken to improve the efficiency of the existing major intercity highways. These actions can be oriented either towards improving the flow in general or towards providing selective service advantages to a particular trip or vehicle type:

Reversible Lanes can be used to unbalance capacity in the direction of the predominant flow such as at work rush hour or major recreation peaks.

Special Purpose Lanes can be used to favor multiple-occupancy vehicles and encourage car pooling. This would reduce the number of vehicles per person moving in the corridor.

Ramp Metering and Dynamic Signing coupled with surveillance techniques can assist in increasing vehicle flow on a given section of highway.

Tolls (ignoring legal problems) could be imposed to favor certain trip destinations, lengths, time of travel or vehicle occupancies.

High Speed Lanes might be created by raising the speed limit during certain periods possibly limited to specially licensed drivers.

The above traffic operations improvements are difficult to orient to particular trip types, but would, in general, have the effect of postponing serious congestion. The techniques could be applied on any access-controlled facility in the study region. It is not clear that significant advantages would be offered the intercity traveler.

Short Range--Bus Operations Improvements

Various improvements to the corridor service offered by conventional bus may be the most promising short-run transit improvements. Those discussed below are envisaged for the major routes between metropolitan centers, basically those followed by Greyhound and Trailways service today--I-80, I-580/205 and I-99.

Improved Frequency of Service would increase the convenience of bus usage. Hourly service is now offered San Francisco to Sacramento. Oakland to Sacramento service is offered 7 times daily. Similar service could be instituted to Stockton and between Stockton and Sacramento.

Increased Coverage of Express Bus Service is needed since express service between the Bay Area and Sacramento leaves only from San Francisco terminal, Oakland Greyhound Station and Richmond. There is no express service from the South Bay and no pick-up points in other major population centers. Stockton service stops at Oakland, San Leandro, Hayward and Tracy, but sacrifices express time for this coverage. The solution to this problem would be a series of express buses with origins at several major centers in the Bay Area.

BART/Bus Interface is totally lacking at present. The Greyhound stops in Oakland and Richmond are not convenient to BART stations. This is also true for Stockton service. If inter-intraurban transfers can be made convenient, it is possible that the coverage of intercity buses could be vastly extended. Such interfacing would aid both types of transit.

Bus-Auto Interface is also difficult since no conveinent park/ride facilities are offered for bus travelers in the downtown bus terminal areas. This suggests the possibility of special bus park/ride lots located just outside dense areas as potential collection points for intercity travelers. North of Richmond and in Castro Valley might be such locations to serve the Sacramento and Stockton service.

Exclusive Lanes are a means of improving the comparative advantage of bus service over the automobile. Lanes can be subtracted from an existing freeway to create special congestion-free high speed bus lanes. At present there are at least two major shortcomings to this approach. First, the major need for "comparative advantage" is within urban areas and on the fringe where the congestion is greatest. It is here, however, where creating the special lanes would remove needed lanes from automobile service.

The second shortcoming is that with the exception of I-80, none of the study region access controlled facilities are large enough for lane subtraction in most areas. These limitations suggest the attractiveness of the busway concept (see below).

Special Government Shuttles may be viable means of encouraging bus usage between government offices in Sacramento and the Bay Area. A scheduled service with specific, government-related destinations would demonstrate the State's commitment to transit while providing a convenient service for employees and limiting the need for the State Motor Vehicle Pool. A survey of government employee travel to be carried out in the next phase may also suggest other special services.

Group Rates would help make bus travel economically competitive for family or other group travel.

Increased Charter Operations catering to skiers and nightlifers might offer service with advantages over the automobile. Bus patronage to Reno is one of the few routes with strong ridership patterns. Improved special service operations should be investigated.

Short Range--Conventional Rail Operations Improvements

The AMTRAK service between the Bay Area and Sacramento is an accidental by-product of the thrice-weekly San Francisco to Chicago service. Any major service improvement would probably be at Federal or State government sponsorship since private carriers are attempting to phase out of the passenger service.

Increased Frequency of Service between the Bay Area and Sacramento would be the basic rail improvement under conventional operations. Four trips per day in each direction -- San Jose, Oakland, Fairfield, Sacramento--would provide a substantial service improvement that would make rail service attractive to business and Government travelers. Bay Area to Stockton service should be considered.

New Passenger Routes should be considered in addition to increasing service on the Oakland-Sacramento Southern Pacific Routes (with new

stations at Martinez, Fairfield [Travis] and Davis). A major route for investigation is an Oakland-Stockton route via Santa Fe tracks through Martinez, Pittsburg, and Tracy. In addition, a Southern Route to Stockton from Oakland via Southern Pacific with stops at Freemont, Livemore and Tracy could be considered.

Improved BART/AMTRAK Interface would be an essential component of improved inter-intraurban travel. At present, transit-to-rail transfers are difficult. Station relocation or special connections could be considered.

Convenient Schedules are not part of the current rail picture since AMTRAK service is oriented towards the Chicago passenger. To attract the intercity traveler, the metroliner experience has shown that A.M. and P.M. business schedules must be carefully arranged.

Special Recreation Trains such as ski trains or casino trains have been popular and successful abroad. Ski train service is also now being experimented within the East. Since such travel tends to bunch and is not completely reliant on automobile, special trains might be considered. However, special destination connections would be required at the Sierra end of the trip and track speeds are very low.

Short Range--Conventional Air Operations

Study Area air travel suffers from the same problems that California corridor and interstate air travel must deal with--inadequate airport access and long waiting times. These shortcomings become especially important for short trips such as the 100-mile trips under consideration in this study and tend to discourage air travel except for transferring passengers or those who live near the airport. There is little that conventional air operations can do to improve this picture.

Increased Frequency of Service might attract a few more passengers although hourly service is nearly achieved at present during the day.

Addition of Service from Other Bay Area Airports would be a more significant step. Only San Francisco to Sacramento scheduled service is offered on a full schedule. An increase in the number of airports with service to Sacramento and Stockton would increase the convenience of air travel.

Improvement in Terminal Transit Access is necessary to tie the intercity air system into the urban transit system. BART extensions to both the San Francisco and Oakland Airports are currently under study.

VIII.B. Middle Range--Highways

Major Highway Upgrading is among the possible improvements for the 10-15 year time frame. Major highway improvements would be oriented towards achieving 2 to 3-lane directional capacity continuous on the major intercity routes. Such options would therefore include increasing I-80 to a full 8-lane expressway between Sacramento and Oakland, new lanes added to I-580 and I-680 to achieve 6 full lanes, upgrading of Route 4 to at least 4 lanes fully access controlled over its full length to Stockton, and upgrading of Route 99.

Other highway improvements on the Division of Highways program might also be considered, but the above improvements are those primarily aimed at intercity travel.

New Highways are an additional possibility particularly the completion of I-5 between Stockton and Sacramento. An additional new facility with possible intercity potential, but not currently part of official plans would be an east-west route connecting Santa Rosa and Fairfield. Access from Solano County to the Capitol is currently very indirect. Such a new route is not without serious physical and environmental problems.

Middle Range--Busways

As indicated in the short-range improvements, bus service suffers from being mixed with general traffic. A separate R.O.W. would permit high speed (80 mph) bus service, competitive with the automobile.

In addition, a busway on its own right-of-way is the logical first step towards establishing a dual-mode system. The construction of a separate right-of-way for buses is as difficult as adding 2 lanes to a highway. A study of the available rights-of-way associated with the existing highways has been carried out and is summarized in Figure

I-80 busway is the leading candidate for an exclusive right-of-way, given the difficulty of acquiring new rights-of-way. The possibility of establishing a busway on rail rights-of-way or power line rights-of-way will be examined during the next phase.

Middle Range--High Speed Rail

The Advanced Passenger Train technology could be instituted on any of the existing rail rights-of-way from a technical point of view. The Oakland/Sacramento Southern Pacific Line and the Santa Fe Line to Stockton via Pittsburg, and the Southern Pacific Line via Tracy are the other major

candidates from a market point of view. Freight conflicts, train controls, grade crossing and other safety questions are major impediments to be investigated.

Middle Range--Rapid Transit

BART Continuations for intercity service have been considered in conjunction with the BART extension studies currently underway. The BART studies are considering extensions to the Pittsburg/Antioch and Livermore/Pleasanton areas. Several possibilities exist for continuing BART beyond the extension terminals to Sacramento or Stockton and points in between.

Five major extension possibilities have been identified:

- Richmond/Pinole/Vallejo/Fairfield/Davis/Sacramento (via a new bridge and then using Southern Pacific tracks).
- Concord/Benecia/Fairfield (Travis)/Davis/Sacramento (via a new bridge and then using Southern Pacific tracks).
- Pittsburg/Travis (Fairfield)/Davis/Sacramento (possibly via the proposed Pittsburg/Antioch bridge, then following the old Sacramento Northern right-of-way to Fairfield, then via Southern Pacific tracks).
- Pittsburg/Brentwood/Stockton (via Santa Fe tracks).

Each of these route alternatives could work in one of two possible operating configurations. First, a cross-platform transfer could be established at the outer terminus of the rapid transit extension where transfer would be made to special equipment for the intercity run. This equipment could be conventional rail equipment (for railroad compatability) or custom-designed intercity transit equipment.

An alternative would be "BART cars" which would make a continuous run on intercity routes, but also integrate into BART's metropolitan system. This would require dual guage equipment or new tracks beyond BART at the BART guage.

Other questions of compatible equipment design, performance, and scheduling will be examined during the next phase.

The BART extension concept raises the issue of the need for intermodal coordination to service the intercity runs--bus feeders and park/ride facilities. In addition, the question of BART extensions down the peninsula are important for distribution purposes.

STOL Systems are an additional middle range possibility. STOL equipment is becoming available, but equipment is not the major issue since available commuter-type aircraft could improve service if airports were more widespread. The major issue for STOL service in the Bay Area remains the location of STOL facilities. Several locations have been studied as at Richmond, Oakland, Concord, Livermore, Santa Rosa, as well as several sites in the Bay and on the San Francisco waterfront. A selection of these sites establishing a constellation of facilities with substantially improved access is fundamental to the success of the STOL concept.

VIII.C. Long Range

Dual-Mode Guideway combining transit and off-line capabilities is the ultimate evolution of the highway or busway. Any major highway could be converted to dual-mode given an available technology. However, dual-mode attractiveness revolves primarily around its high capacity. It is unlikely that dual-mode capacity would be needed anywhere in the study area by 1995, but certainly the leading candidate for first steps is the I-80 corridor between Sacramento and the Bay Area.

High Speed Ground Transportation such as the tracked levitated vehicles being developed by U. S. DOT also require substantial patronage if capital costs are to be justified. This may suggest that a Bay Area to Sacramento system should be thought of as an extension of a San Diego to San Francisco system where the speed and market may justify such a system in the long run. Two routes suggest themselves within this assumption--a San Jose/Oakland/Fairfield (Travis)/Sacramento route assuming a major East Bay stop. The other route possible is a Central Valley alignment assuming a HSGT coming to the Bay Area from Los Angeles via Bakersfield-Fresno and connecting with the Bay Area via BART at Concord, crossing the Straits and continuing to Sacramento via Fairfield (Travis). It is possible that a HSGT technology may develop which could be justified within the study area alone. The San Jose/Oakland/Fairfield (Travis)/Sacramento route would be the prime candidate in terms of market although a Stockton route should be investigated. HSGT right-of-way requirement and station spacing suggest the possibility of alignments that are not within those of existing transportation systems such as rail or highway rights-of-way. The abandoned Sacramento Northern right-of-way from Collinsville to Sacramento with a curve towards Travis (Fairfield) is a possibility for further investigation. Power line rights-of-way will also be investigated.

V/STOL Systems do not appear to offer advantages over STOL service for the distances under consideration and have considerably higher costs as well as equivalent environmental problems. The same array of Bay Area V/STOL ports are posibilities with similar qualifications as are possible for STOL service.

VIII.D. Baseline Improvement Program Components Chosen For Testing

From the broad range of short, middle and long-range transportation improvement possibilities, 5 technologies and 9 routes were selected in combinations for testing. These selections were designed to develop three types of information:

- How significantly different systems on similar alignments with similar potential transit markets would perform in respect to attracting patronage.
- How identical technologies in different routes (serving different markets) would perform in respect to patronage.
- How varying assumptions in the testing process such as feeder systems, frequency, speed, cost, etc., affect the potential transit patronage.

The motive for the test structure was thus a dual one--to learn about the transit market in general in major portions of the study area and to learn about the relative attractiveness of different system types in a variety of operating configurations. Not all reasonable routes have been tested. The routes selected for testing in this phase are those most directly joining the major population centers to the Bay Area in a corridor or roughly linear configurations reasonable for fixed route transit.

No forecasting has been carried out for the Stockton to Sacramento market. This will be done in the next phase; nor have all the promising technologies been tested. Several options such as conventional air, major highway upgrading, advanced passenger trains and dual-mode guideway await further testing.

Below are described the 9 route/technology combinations tested in the Schematic Cycle. These are shown in figures 33 through 41.

- Exclusive Bus 1--Connects San Francisco and Oakland with Sacramento along an exclusive or reserved right-of-way paralleling Route 80. Stations are located at San Francisco, Oakland, Vallejo, Fairfield/Travis, and Sacramento.

- Exclusive Bus 2--Similar to Bus 1 except that it only provides stations located in San Francisco, Oakland and Sacramento.

- Conventional Rail 1--Connects Oakland with Sacramento through Martinez along existing railroad rights-of-way. Between Fairfield and Sacramento, the alignment is parallel to Route 80. Stations are located at Oakland, Martinez, Fairfield/Travis, Davis, and Sacramento.

- Conventional Rail 2--Connects Oakland to Stockton. The alignment runs along existing railroad rights-of-way on the northern edge of Contra Costa County, through Tracy enroute to Stockton. Stations are located at Oakland, Martinez, Pittsburg, Tracy, and Stockton.

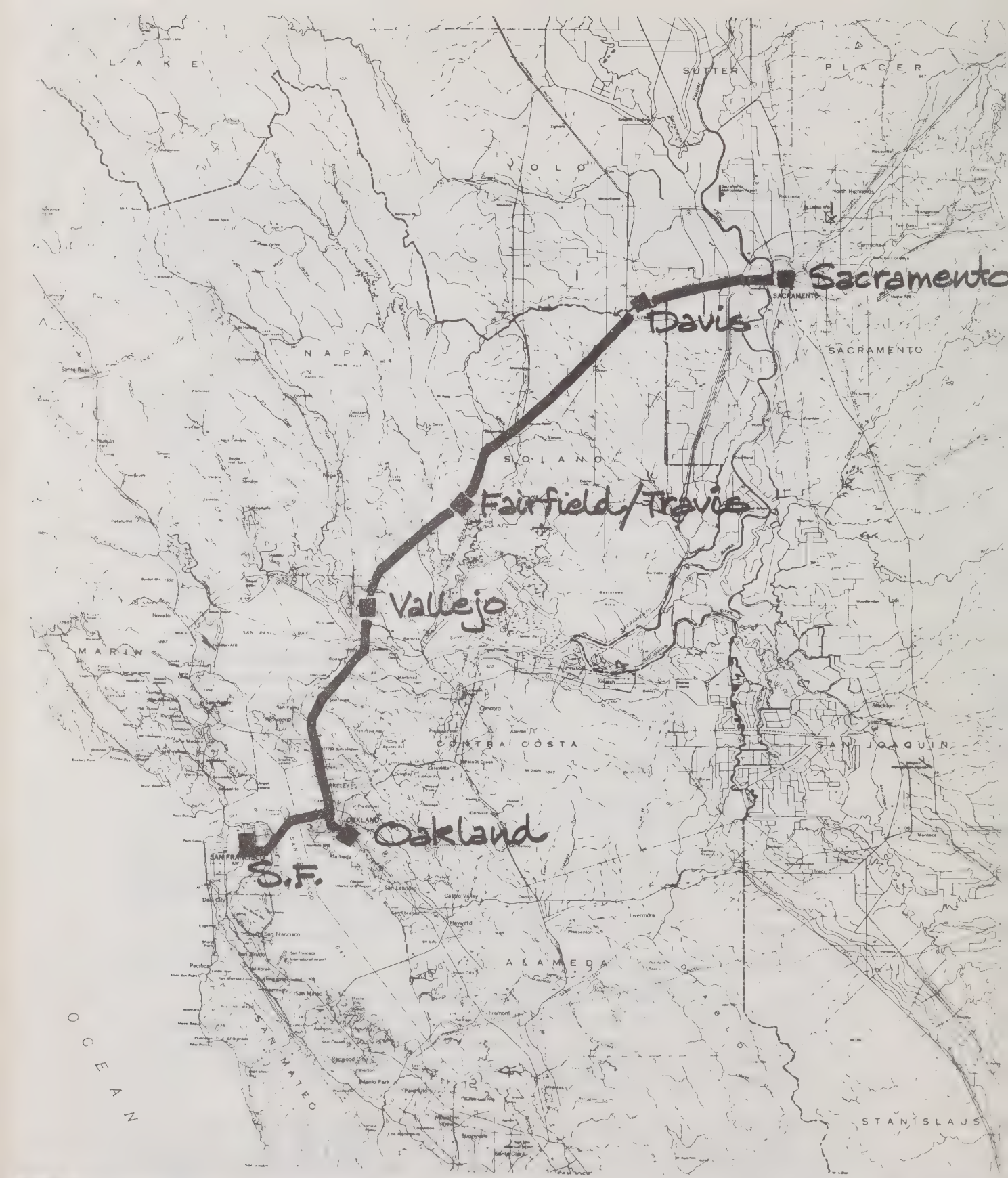
- Conventional Rail 3--Connects Oakland to Stockton along existing railroad rights-of-way via a southern route approximately paralleling Route 50. Stations for this alignment are located at Oakland, Fremont, Livermore, Tracy and Stockton.

- BART 1--An extension from the Richmond Station north along existing railroad rights-of-way approximately paralleling Route 80. Stations are located at Richmond, Pinole, Vallejo, Cordelia, Fairfield/Travis, Davis, and Sacramento.

- BART 2--An extension from the Concord Station east to Pittsburg, then north to Sacramento along existing railroad rights-of-way. This alternative includes five stations located at Concord, Pittsburg, Fairfield/Travis, Davis, and Sacramento.

- High Speed Ground Transportation--Connects San Jose to Sacramento. The alignment runs along the East Bay shoreline, through Martinez and north along existing railroad rights-of-way paralleling Route 80. Stations are located at San Jose, Oakland, Fairfield/Travis, and Sacramento.

- V/STOL--Is a system which connects six major metropolitan areas with a series of air terminals. Terminals are located in San Francisco, Oakland, San Jose, Concord, Stockton, and Sacramento.



SSBACS

SACRAMENTO-STOCKTON-SAN FRANCISCO BAY AREA-CORRIDOR STUDY

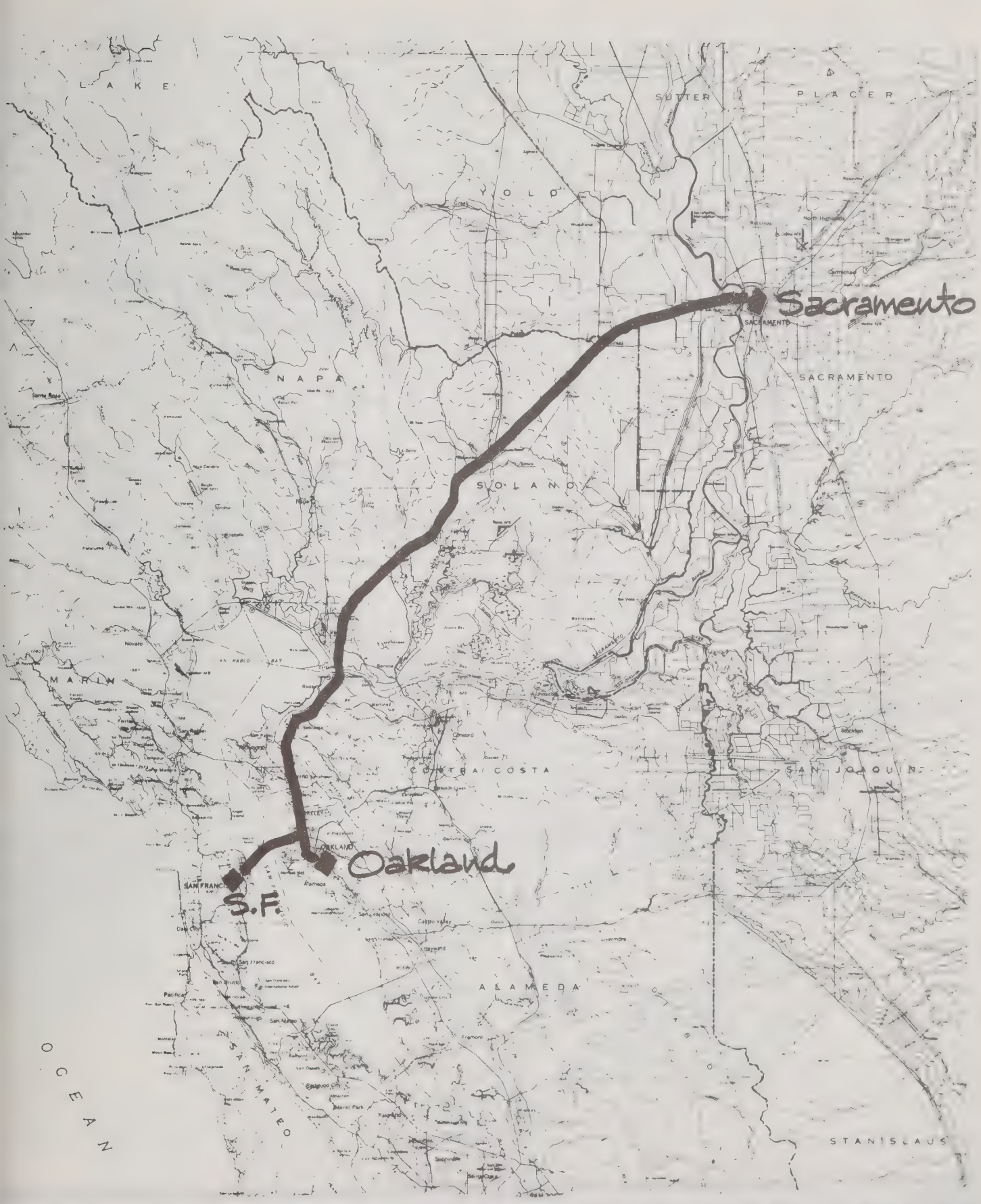
33

EXCLUSIVE BUS #1

0 5 10 15 20 25mi.

AMV	4-2
DRA	
EDAW	
KE	

107



SSBACS

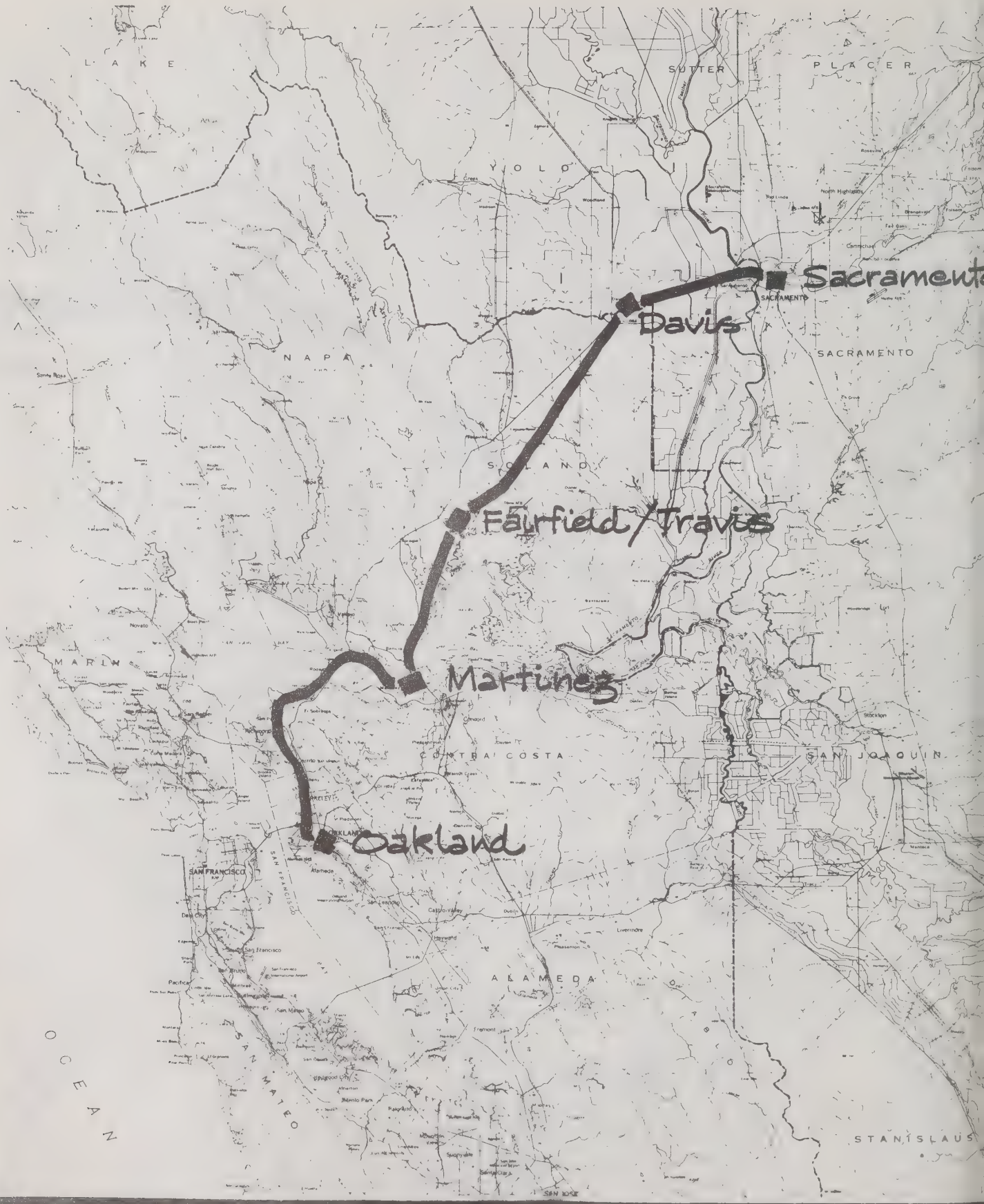
SACRAMENTO·STOCKTON·SAN FRANCISCO BAY AREA·CORRIDOR STUDY 34

EXCLUSIVE BUS #2

0 5 10 15 20 25mi

AMV	4-27
DRA	
EDAW	
KE	

108



SSBACS

SACRAMENTO·STOCKTON·SAN FRANCISCO BAY AREA·CORRIDOR STUDY

35

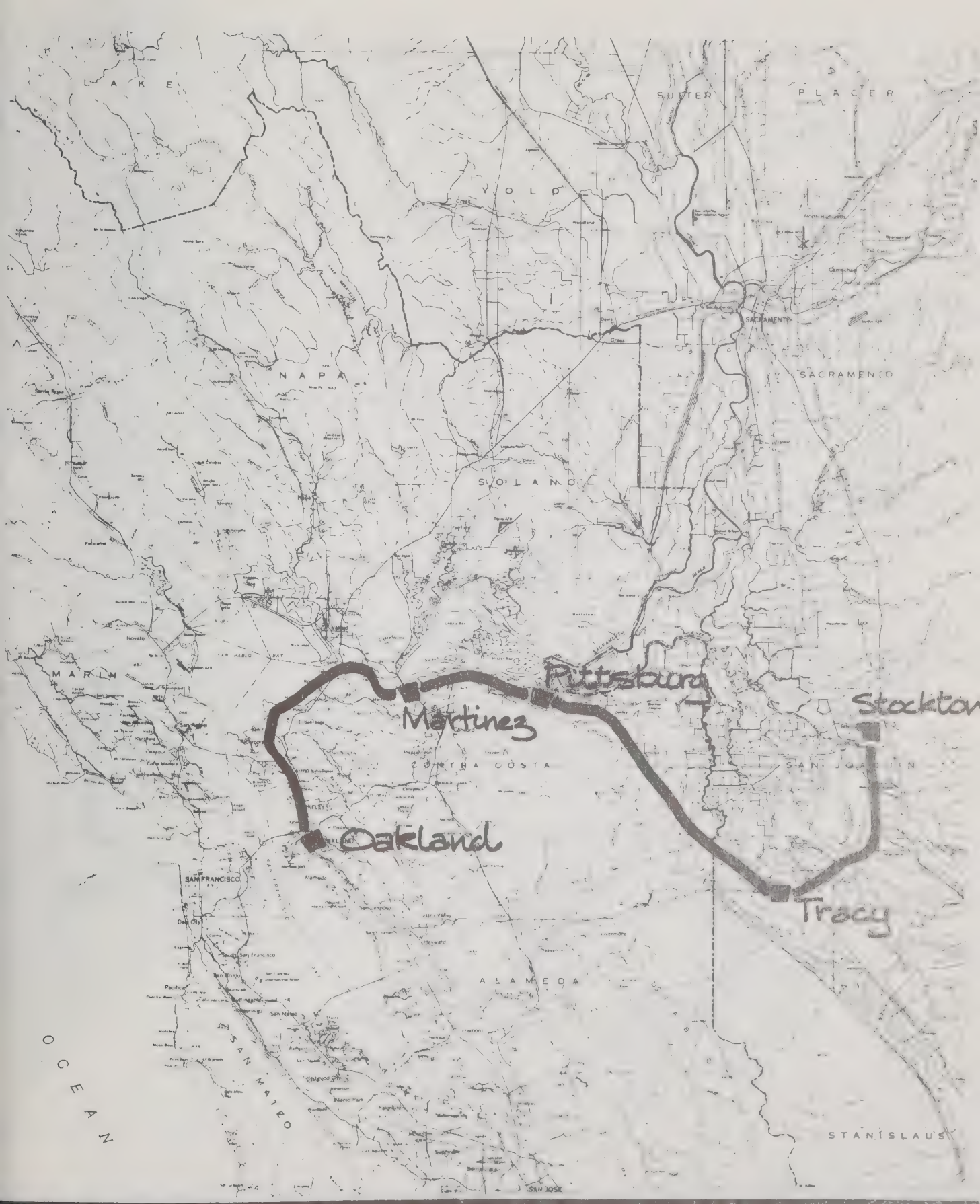
CONVENTICNAL RAIL

#1

0 5 10 15 20 25mi

AMV	4-27
DRA	
EDAW	
KE	

109



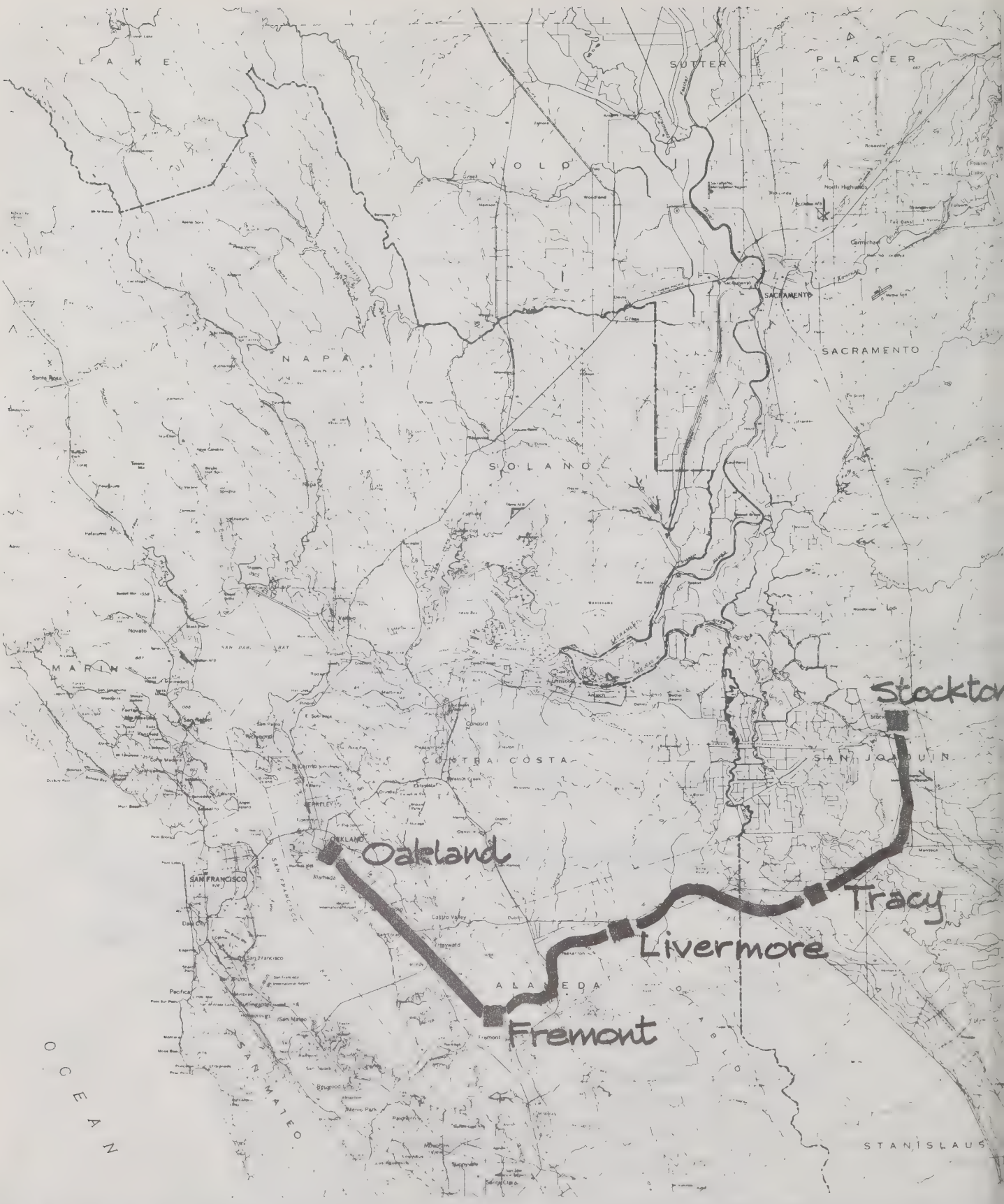
SSBACS

SACRAMENTO·STOCKTON·SAN FRANCISCO BAY AREA·CORRIDOR STUDY

CONVENTIONAL RAIL #2

0 5 10 15 20 25mi

AMV	4-27
DRA	
EDAW	
KE	



SSBACS

SACRAMENTO·STOCKTON·SAN FRANCISCO BAY AREA·CORRIDOR STUDY

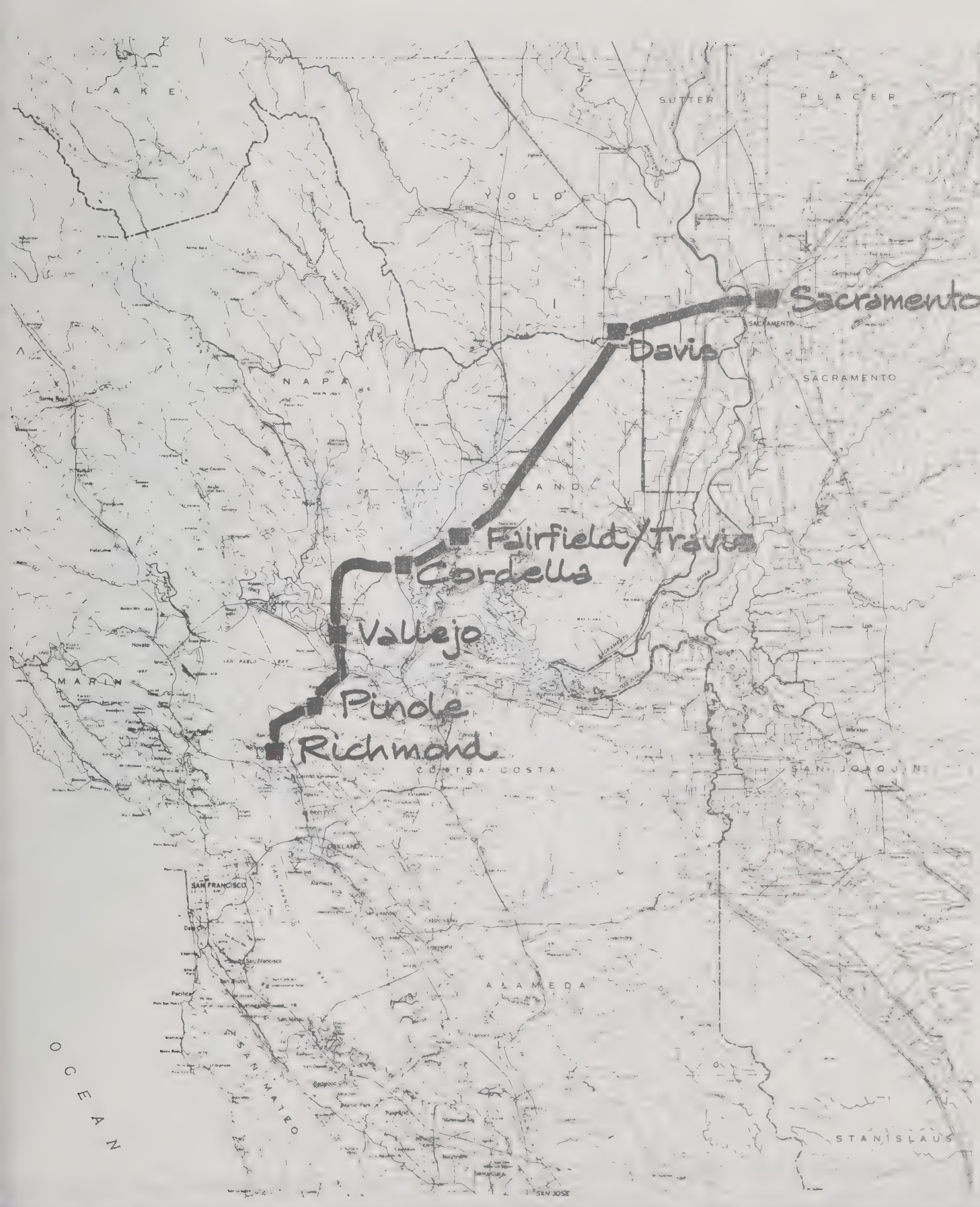
37

CONVENTIONAL
RAIL #3

0 5 10 15 20 25mi

AMV	4-27
DRA	
EDAW	
KE	

111



SSBACS

SACRAMENTO·STOCKTON·SAN FRANCISCO BAY AREA·CORRIDOR STUDY

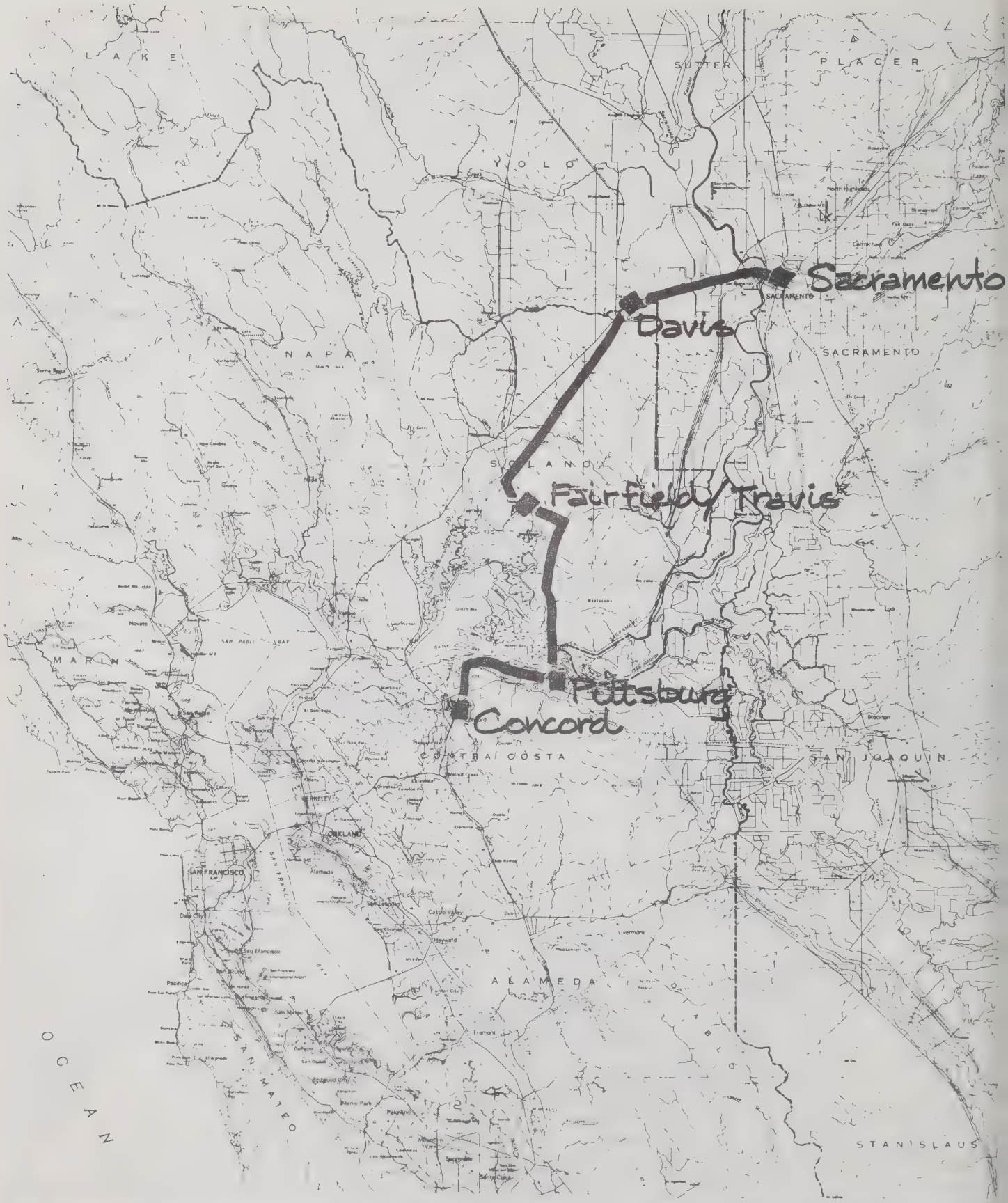
38

BART #1

0 5 10 15 20 25mi

AMV	4-27
DRA	
EDAW	
KE	

112



SSBACS

SACRAMENTO-STOCKTON-SAN FRANCISCO BAY AREA-CORRIDOR STUDY

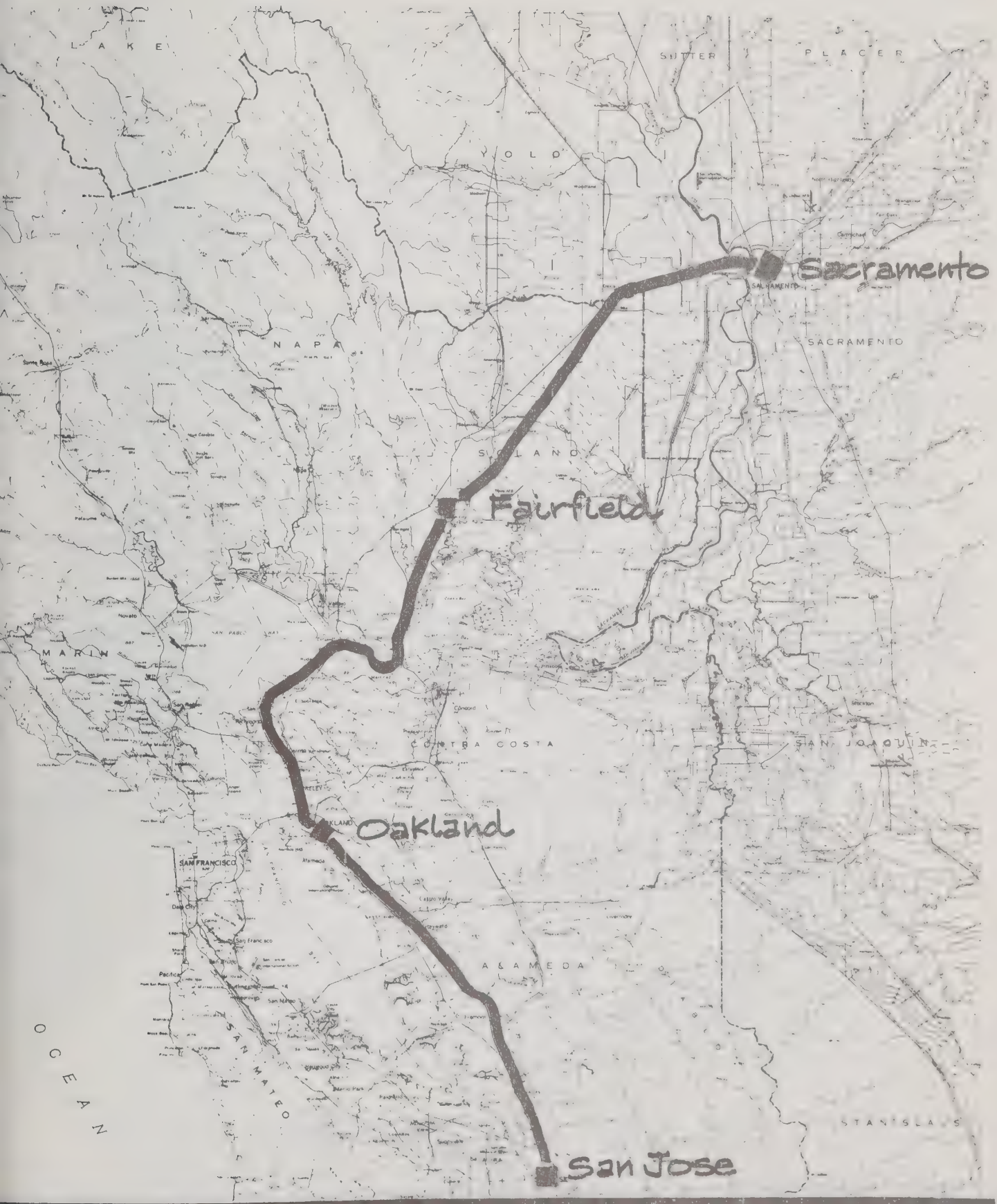
39

BART #2

0 5 10 15 20 25mi

AMV	4-27	
DRA		
EDAW		
KE		

113



SSBACS

SACRAMENTO·STOCKTON·SAN FRANCISCO BAY AREA·CORRIDOR STUDY

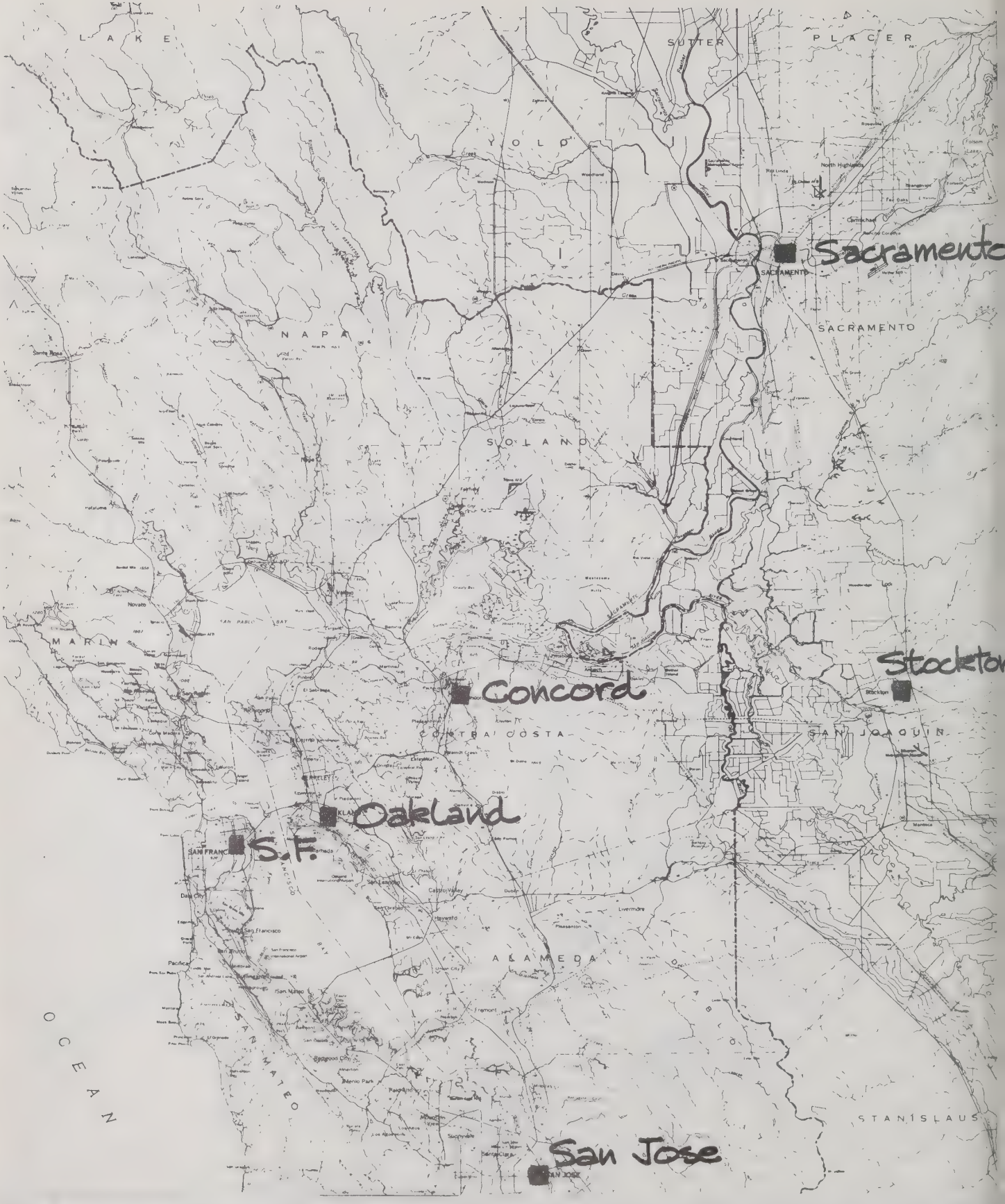
40

H.S.G.T.

0 5 10 15 20 25mi

AMV	4-27
DRA	
EDAW	
KE	

114



SSBACS

SACRAMENTO·STOCKTON·SAN FRANCISCO BAY AREA·CORRIDOR STUDY

41

V/STCL

0 5 10 15 20 25mi

AMV	4-27
DRA	
EDAW	
KE	

115

VIII.E. Access, Speed and Schedule Assumptions

Important assumptions in the testing process were made in respect to the urban feeder systems servicing these intercity improvements and the operations of the systems themselves.

Access to each system was assumed possible by auto, bus, or BART. No constraint was placed on auto access--Kiss/ride or park/ride access was assumed possible. Bus access was assumed possible in areas where municipal bus systems operate. BART access was assumed where intercity system stops and BART stations coincided. Access times were worked out from predicted highway and local street speeds, bus speeds, and BART schedules from the county centroid of population to the nearest test system stop.

Figure 42 indicates the speeds, stops, total trip times and the frequency of service. These assumptions and those concerning the level of feeder service, costs and others have been varied in the forecast to test the sensitivity of potential transit patronage to changes in the assumptions. The sensitivity analysis is discussed in Section XI.

Figure 42 shows the variation in total line-haul times for the different test systems as compared to 3 characteristic automobile times. Line-haul speeds favor the rapid transit and rail systems. Bus in reserved lanes or on an exclusive right-of-way is also faster than auto on the line-haul portion of the trip.

Despite its higher line-haul speeds and lower cost per mile (see Figure 32) transit suffers from a severe access time problem. Simply stated, it is time-consuming and inconvenient for a large proportion of the potential intercity market to get to the transit system. BART, bus or auto feeder systems require a minimum of 1 transfer and often two if there is a walk component to get to a transit feeder system. For each transfer, there is a waiting time penalty weighted by the psychological dislike of having to wait. The access times to intercity transit in the Bay Area run from 20 to as much as 40 minutes, including waiting times.

In addition, access problems exist at the Sacramento or Stockton end of the trip or at intermediate points. Trips to downtown tend to have better access than home trips. However, the total access time at both ends of the trip very often cancels out a transit system improvement's line-haul speed and cost per mile advantages over the automobile.

Thus the access portion of the total transit trip is both time consuming and expensive. For Conventional Rail 1, BART 1 or Exclusive Bus 1, for example, the access portion of the trip between typical trip origins and destinations and the line-haul systems accounts for 60 percent of the total door to door travel time and 20 percent of the total cost of the trip.

By comparison, trips by automobile avoid the time costs associated with getting to and waiting for an intercity transit system. Although the total cost (out-of-pocket plus fixed) is greater per mile of travel for automobile this is in many cases offset by the access problems associated with transit for much of the potential transit market.

In addition, over 50 percent of the longer trips are typically made by groups of more than one person. These are largely non-business trips for such travelers. The costs per mile of operating an automobile are reduced by the number of people traveling. This explains the attractiveness of the automobile for trips with more than one person in the party, particularly for the longer distances.

However, vehicle occupancy reduces as distance reduces and transit therefore becomes more attractive for the intermediate distance trips. This underlines the need to develop systems which cater to both the long and medium distance intercity traveler.

It is likely that work in succeeding phases will have to investigate the access question in considerable detail for those intercity systems which show the greatest promise.

Figure 42

TEST SYSTEM TRAVEL CHARACTERISTICS

System	Station Location	Service Freq.	Max. Speed	Time/Stop	Total Line-haul Terminus to Terminus Trip Time
BART 1	Richmond Pinole Vallejo Cordelia Fairfield/Travis AFB Davis Sacramento	15 min.	80 mph	30 sec	59 min.
BART 2	Concord Pittsburg Travis AFB Davis Sacramento	15 min.	80 mph	30 sec	60 min.
Conv. Rail 1	Oakland Martinez Fairfield/Travis AFB Davis Sacramento	30 min.	100 mph	60 sec	61 min.
Conv. Rail 2	Oakland Martinez Pittsburg Tracy Stockton	30 min.	100 mph	60 sec	67 min.

Figure 42
Test System Travel Characteristics-contd

System	Station Location	Service Freq.	Speed	Time/Stop	Total Line-haul Terminus to Terminus Trip Time
Conv. Rail 3	Oakland Fremont Livermore Tracy Stockton	30 min.	100 mph	60 sec	55 min.
High Sp. Gr. Tr.	San Jose Oakland Fairfield/Travis AFB Sacramento	60 min.	200 mph	120 sec.	56 min.
Excl. Bus 1	San Francisco Oakland Vallejo Fairfield/Travis AFB Davis Sacramento	15 min.	70 mph	60 sec	106 min.
Excl. Bus 2	San Francisco Oakland Sacramento	15 min.	70 mph	60 sec	93 min.
V/STOL	San Francisco Oakland San Jose Concord Sacramento Stockton	60 min.	275 mph	Not Appl.	20-25 min. (Depending on terminal locat.)

Figure 42
Test System Travel Characteristics-contd

System	Trip	Highway Ave. Speed	Travel Time
Automobile	Oakland - Sacramento	55 mph	94 min.
	Oakland - Stockton	55 mph	76 min.
	San Jose - Sacramento	55 mph	126 min.

IX. TRAVEL FORECASTING

IX.A. Travel Forecasting--Introduction

Three criteria structure the approach of the development forecasting methods. First, the methodology as used must be sensitive to the differences among transportation improvement alternatives. Secondly, the methods must be able to make use of the base data which is available. Thirdly, it must permit the type of sensitivity testing to alternative assumptions where data uncertainty exists or where value positions would yield different results.

Conventional travel forecasting is a sequential process. The region under study is first divided up into smaller areas. The activities generating trips between or within these areas (called zones or districts) are inventoried and projected for each zone. Networks are coded that indicate the transportation system for each mode serving the area. These networks contain nodes, abstract representation of intersections (or stops--depending on the mode) and links, the route section between the nodes.

Trips in and out of each zone are related to activities in that zone. Total trips into and out of each zone are forecast using these relationships. The trips are then distributed between zones based on the relative numbers of trips produced and attracted by the zones, the travel times and costs between zones. The resulting table of interzonal trips are then split between modes on the basis of the transportation system characteristics of each mode, the purpose of the trip, and the characteristics of the tripmakers particularly car ownership. Trips between zones are assigned to the shortest route between zones and flows on each link are accumulated. These accumulations are the traffic or ridership on each link.

IX.B. Data Base and Survey Needs

There is presently only fragmentary base year intercity travel data available. No external (interurban) travel data is currently available for the nine county Bay Area--the major trip-generating area.

The Statewide Transportation Study developed a vehicle trip model to simulate 1970 vehicle travel statewide and to forecast future, 1995, vehicle trips patterns. Within the SSSBACS area, the Statewide Study used model parameters from the Stockton, Sacramento and Bay Area Transportation Studies. However, no data on external trips (outside the Bay Area to other urban areas) or corridor interview data from the Bay Area Study was available to validate the Statewide Model for long-distance trips in and out of the nine-county area. Also, the Statewide Model itself has not been calibrated to accurately forecast origins and destinations for long trips. Its purpose was to develop aggregate measures of total vehicle travel.

Finally, no compatible bus, rail or other transit base data or forecasts exist. Air travel surveys are available, but only at a county-to-county scale.

The present study has therefore developed four parallel streams of work to overcome this lack of reliable information. First, in the short run, modifications have been made to the Statewide Transportation Study data to bring its intercounty forecasts more closely into line with the data developed by the three urban studies in the Study Area. In addition, behavioral relationships from the Northeast Corridor Intercity Study have been analyzed and applied to convert the adjusted vehicle estimates into person movements.

Second, in order to develop a more reliable basis for forecasting in the next phase, a process is under way to develop new disaggregated base year information on the household level through a reformating of the basic home interview files.

Third, new roadside interviews are being taken to develop new behavioral-based information on intercity travel. At several key route locations in the Study area, license plates have been photographed and a postcard mail-back survey carried out. This process, first carried out in March, will be repeated during the summer to capture both winter and summer-related travel patterns. This survey process will be supplemented by surveys of air, bus and rail travelers as well as a special survey of Government workers.

Fourth, a new direct demand travel forecasting model is being developed. This will be a single step model, sensitive to the travel induced by new modes. The model will be run on a new data base developed from the surveys and home interview files discussed above.

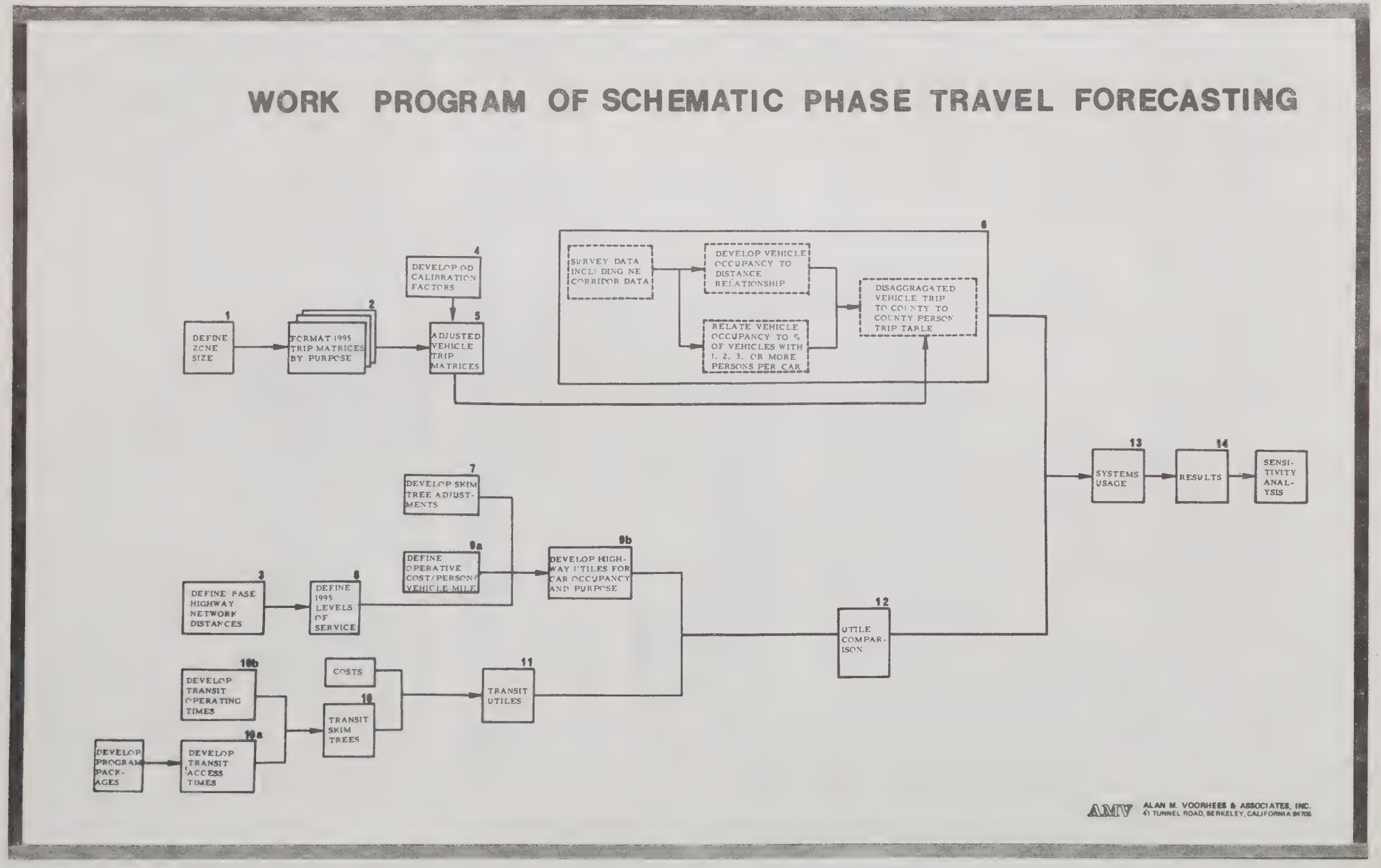
IX.C. Schematic Cycle Transportation Forecasting

The following is a brief description of the major characteristics of the travel forecasting methods employed in the schematic phase. The basic work was oriented towards converting the Statewide Transportation Study "vehicle" trip tables into "person" trip tables so that intercity mode choice criteria could be applied to estimate the patronage assoicated with selected improvement programs for 1995. The flow diagram in figure 43 indicates the major steps:

- Counties were used as the geographic unit for forecasting.

- County-to-county vehicle trips were developed for five travel purposes by using the statewide 1995 vehicle trip-tables. These 1995 tables are based on State Department of Finance projections and are equivalent to Alternative Future Two. The five travel purposes used were: home-work, home-shop, home-other, other-other, recreation.

Figure 43


WORK PROGRAM OF SCHEMATIC PHASE TRAVEL FORECASTING
1
DEFINE ZONE SIZE
2
FORMAT 1995 TRIP MATRICES BY PURPOSE
4
DEVELOP OD CALIBRATION FACTORS
5
ADJUSTED VEHICLE TRIP MATRICES
6
SURVEY DATA INCLUDING NE CORRIDOR DATA
DEVELOP VEHICLE OCCUPANCY TO DISTANCE RELATIONSHIP
RELATE VEHICLE OCCUPANCY TO % OF VEHICLES WITH 1, 2, 3, OR MORE PERSONS PER CAR
DISAGGRAGATED VEHICLE TRIP TO COUNTY TO COUNTY PERSON TRIP TABLE
7
DEVELOP SKIM TREE ADJUSTMENTS
3
DEFINE BASE HIGHWAY NETWORK DISTANCES
8
DEFINE 1995 LEVELS OF SERVICE
9a
DEFINE OPERATIVE COST/PERSON/VEHICLE MILE
9b
DEVELOP HIGHWAY UTILES FOR CAR OCCUPANCY AND PURPOSE
10b
DEVELOP TRANSIT OPERATING TIMES
10a
DEVELOP TRANSIT ACCESS TIMES
DEVELOP PROGRAM PACKAGES
COSTS
10
TRANSIT SKIM TREES
11
TRANSIT UTILES
12
UTILE COMPARISON
13
SYSTEMS USAGE
14
RESULTS
SENSITIVITY ANALYSIS
AMV
ALAN M. VOORHEES & ASSOCIATES, INC.
41 TUNNEL ROAD, BERKELEY, CALIFORNIA 94705

- The Sacramento and Stockton Transportation Studies were used to develop county-to-county trip interchange factors which varied by county density and interchange distance. These factors were applied to the Statewide Model Vehicle trip table through regression analysis to adjust the county-to-county movements.

- Using relationships between trip distance by purpose and vehicle occupancy developed from the Northeast Corridor Intercity Study, Statewide Model Vehicle trip tables were converted to yield county-to-county person trip interchanges. These interchanges were disaggregated by trip purpose and vehicle occupancy.

- Time and cost penalties incuding access, running, waiting and transfer and operating costs were estimated for each county-to-county automobile movement. Average 1995 highway and local street speeds were estimated, including different speed assumptions for different trip types during the time of day of travel. Operating costs at 12¢/mile and cost of users time at $3.00/hour were also used to calculate the cost of trip-making by highway.

- In this schematic analysis no assignment of urban trips was made. However, the competition between intra and interurban trips for facilities was reflected in the choice of highway and local street speeds.

- Time and cost penalties were also developed for the transit alternatives, including access time (by bus, car or BART). Included were access fares, transfer and waiting times. Actual fares and $3.00/hour for users time were also included.

- For each transit system tested, the time and cost difference (including a weighting factor for waiting time) were calculated compared to the automobile for each possible county-to-county interchange. Where the transit penalty was lower, it was assumed that all trips making that movement would go by transit since it appeared to be cheaper, faster or more convenient. For recreation trips, however, only 50 percent of the trips were allowed to divert, reflecting the factors in that trip purpose not included in the model which favor automobile haul, (e.g. recreation vehicles).

- Individual county interchanges from the Statewide Model and early Bay Area Transportation Study (BATS) data were compared and trip tables were adjusted to match the BATS information.

- Transit patronage was then developed for each of the base systems being tested using the county-to-county intercity trip market potential and the service areas of each test system.

- The evaluation process in this phase then focused on the relative performance of transit systems, compared to the automobile in offering improved service to the intercity market. The measure of evaluation used was the percent of intercity market diverted to transit compared to automobile.

X. FORECASTING RESULTS

X.A. The Intercity Transportation Market Potential

Total person trips in the study area were forecast by the State to increase from 11,700,000 in 1966 to 23,400,000 in 1995. This 100% increase in trip-making assumes an activity forecast similar to Alternative Future Two with an overall population increase of 57 percent.

Within the twenty county study area, the statewide model indicates that 85 percent or 19,800,000 trips would not cross county boundaries and are, with some exceptions, not prime candidates for intercity travel. Some travel wholly within a given county will use an intercity system if two stops are located within a given county. This is the case for only two systems tested.

During this phase a limited number of baseline improvements were tested. These improvements did not serve all counties within the study areas directly. The 12 counties served by the test systems appear to have 2,100,000 intercounty trips (1995 statewide projections). This market constitutes 9 percent of the total trips in the study area.

Figure 44 shows the relationship between the average number of vehicle trips made in the study area and their length. As can be seen, the vast bulk of trips are short trips. Trips less than 30 minutes (the average work trip) are over 80 percent of all trips. If intercity trips are considered all trips over 50 miles long then constitute less than 10 percent of the total vehicle trips made each day.

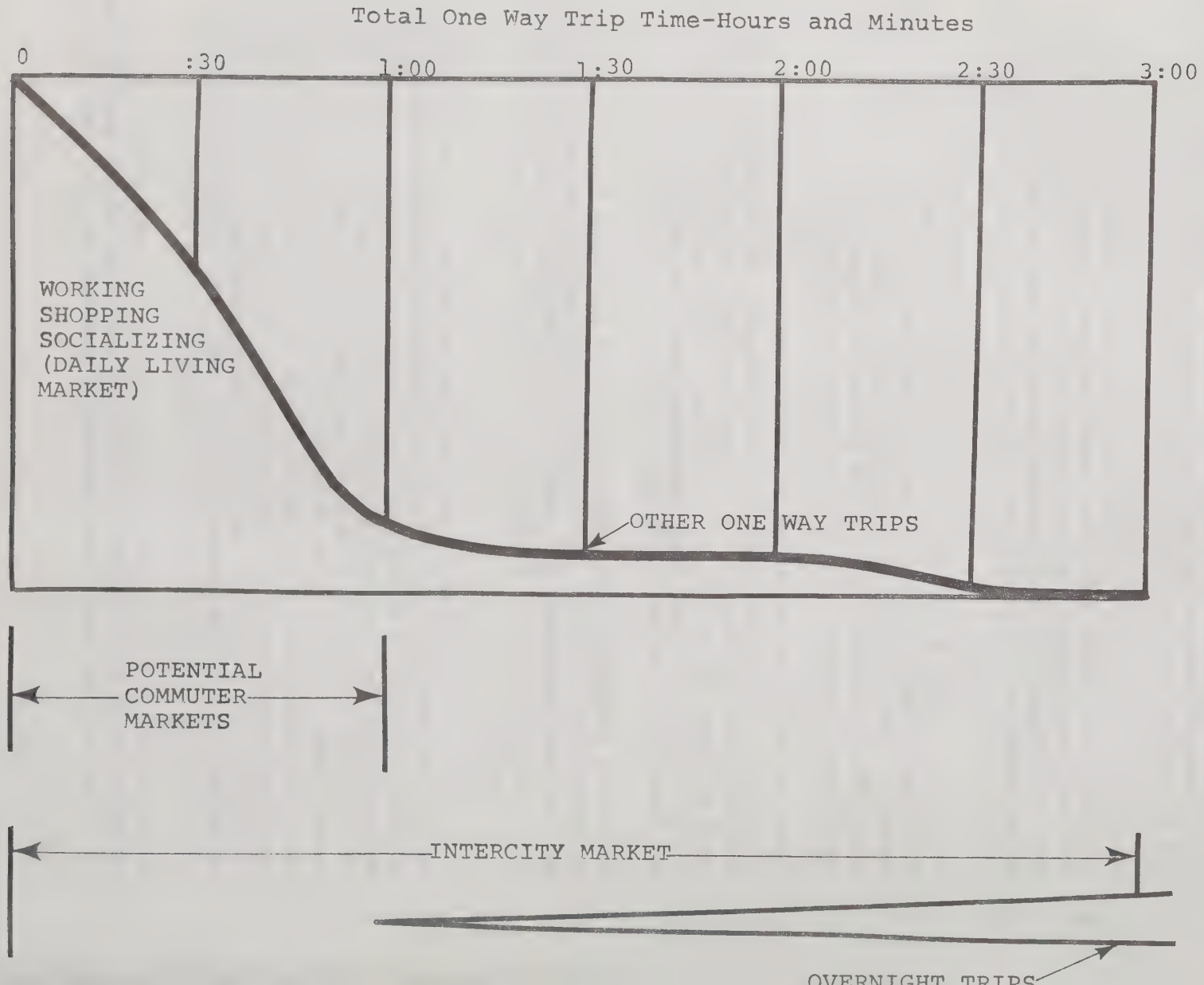
If present trends were extrapolated, nearly all those intercity trips would be made by auto. Today, for example, 90 percent of the trips between the Bay Area and Sacramento are made by car, 8 percent by bus, and 2 percent by air. Bus travel in the study area is currently on the decline and air travel is increasing.

Trips divertible to transit have been estimated for the I-80/Southern Pacific "subcorridor" route between Oakland and Sacramento and for the route 680/Southern Pacific subcorridor to Stockton as indicated in figure 45. Divertible trips for this analysis are those intercounty trips for which one of the 6 basline systems described in section VIII.D. provide the cheapest and/or fastest route. To avoid the inter-intraurban travel confusion, transbay trips have been excluded--that is, estimates do not include trips which might use an intercity system simply to make the San Francisco/Oakland trip. The total divertible market for the Bay Area to Sacramento route described above and including intermediate movements is 212,000. The market for Bay Area to Stockton trips is 44,000 to 58,000 depending on the route.

It is evident from this analysis that even if the entire intercity market served by the 6 test systems was successfully diverted to transit, the reduction in total study area automobile movement would be comparatively

figure 44

MARKET CLASSIFICATION BY TRAVEL TIME



small. The total market potential is 9 percent at maximum and well over half of these trips are not making movements corresponding to the major intercity routes. When consideration is given to possible intercity routes and services this market drops to approximately 1% of all the vehicle trips in the region.

These potential divertible trips while small in terms of percentage of total movements in the study area consist of longer than average trips--from 20 to 80 miles compared with the average 9-mile work trip and the vast percentage of trips which are even shorter. Therefore, diversion of these trips can be significant in terms of reducing the total vehicle modes of travel in the corridor.

In addition, diversion of these trips could have a significant impact on the level of service offered by highways which serve intercity travel such as I-80 and I-680. These facilities will be experiencing increasing congestion in the future if trip-making increases by 100 percent by 1995 as forecast by the State.

Certain trip types will be more affected by diversion than others. The divertible market described above consists of 21 percent home-to-work trips, 37 percent home-to-other, 8 percent home-to-shop, 13 percent recreation trips, and 21 percent non-home based trips. The home-to-work and home-to-"other" purpose trips form 58 percent of the total divertible market. It is these trips, particularly the business-related trips which are the major candidates for diversion to transit. This results from three factors:

- Business trips frequently have at least one end of the trip in the heart of major metropolitan areas. The attractiveness of modes that offer uncongested flow to the city centers is evident.

- Most business tripmakers place a higher value on their time. Any system that can reduce that item in the total cost of travel provides distinct benefits.

- Business trips, particularly those paid by the employing company have been shown to be least elastic to out-of-pocket costs, i.e., fares, again for evident reasons.

Recreation trips cannot be so easily classified. Trips headed for destinations near potential transit stations are divertible. These types of trip includes social or "dressy" trips to downtown San Francisco, Reno, or Lake Tahoe. Trips with dispersed trip destinations, into the Sierras, for example, are much less likely to be diverted. This is particularly true of recreation "messy" tripmakers who carry their equipment with them. Such trips include hunting trips and camping trips, particularly those camping trips using recreation vehicles.

One final point needs to be made about the possible impact of alternative modes in the corridor. That is that the presence of new transportation facilities, particularly fast, high service modes has the potential of changing trip-making patterns considerably. The effect, the so-called "induced" traffic impact needs to be considered in later stages of the study.

This transit market potential can also be broken down on a county-to-county basis. Figure 45 shows the intercounty trips, indicating the geographical distribution of the intercity travel.

The purposes of developing an understanding of the intercity transit market, the urban transit market within the Bay Area was subtracted out and not included in either the market forecast or the testing of systems for patronage. In other words, no attempt was made in this phase to determine the degree to which systems designed primarily for interurban travel would compete with the existing urban bus and rapid transit in instances where parallel service was provided.

These trips within the urban area will provide an additional potential market for new systems which serve the urban area, as well as the interurban market. Estimates of the urban patronage contribution will be made in the next phase.

Contra Costa, Solano and Sacramento counties account for 57% of the total trips between the counties in the Study Area. This results from the existing pattern of urbanization along the I-80 corridor which generates these heavy intercounty movements. Many of the heavier trip interchanges, such as Yolo to Sacramento, Solano to Contra Costa and Yolo to Solano are shorter trips between adjacent counties. The longer trips, between Bay Area Counties and Sacramento are the smaller in number. The systems tested cater to different mixes of these longer and shorter intercity trips depending on the location of stops.

Figure 45

1995 TOTAL INTERCITY TRAVEL MARKET BY COUNTY *

Sacramento-San Francisco Sub-Corridor

	Sacramento	Yolo	Solano	Napa	San Joaquin
Sacramento	-				-
Yolo	35.2				-
Solano	11.1	26.5			10.8
Napa	2.3	1.2			0.7
Sonoma	2.7	0.8	26.0		0.8
Marin	1.0	0.6	6.4		2.5
Contra Costa	3.5	1.3	41.1	13.6	10.3
Alameda	1.9	0.8	15.0	8.5	13.7
Santa Clara	1.2	0.4	3.4	2.4	3.5
San Mateo	0.4	0.3	2.0	0.7	0.7
San Francisco	1.0	0.2	3.0	2.8	0.7

*Intercity trips within East Bay and Transbay trips excluded.

Note: a) Sacramento-San Francisco Sub Corridor market total = 211,400 person trips.
b) San Joaquin-San Francisco Sub Corridor market total
= 43,800 -Conventional Rail #3 and 58,000 -Conventional Rail #2.

Figure 46

PRELIMINARY ESTIMATES OF SYSTEM PERFORMANCE
Sacramento-Bay Area Sub-Corridor
1995 2-WAY INTERCITY PERSON-TRIP ENDS

County	Intercounty Potential		% of Potential Diverted to:						
	Num(000)	% Total	BART 1	BART	Conv Rail	Bus 1	Bus 2	HSGT	V/STOL
Sacramento	60	14	25.8	11.5	25.3	15.4	4.8	21.8	3.4
Yolo	67	16	18.3	4.9	6.2	16.4	0.6	0.7	0.4
Solano	129	29	17.6	2.1	16.4	14.8	-	11.6	-
Napa	32	8	18.0	-	28.2	13.2	-	11.4	
Sonoma	23	6	8.3	-	-	3.3	-	-	-
Marin	8	2	9.0	-	5.7	5.4	-	-	-
Contra Costa	59	14	2.1	2.3	24.0	2.4	1.7	2.0	1.7
Alameda	26	6	32.8	3.0	33.8	32.5	5.2	24.1	1.9
Santa Clara	7	2	-	-	-			49.5	4.7
San Mateo	4	1	37.6	6.9	30.8	24.4	7.1	22.5	6.9
San Francisco	7	2	30.0	4.1	35.0	28.0	10.0	35.5	3.4
Total	423	100							
System Patronage (000)*			36	8	38	29	3	23	2
Percent of Potential			17%	3%	18%	14%	1.6%	11%	1.1%

*Includes only those person trips diverted from auto

X.B. Patronage on Test Systems--Bay Area/Sacramento

Using the approach described in section IX.C. patronage estimates were made for each test system, assuming it was in place and competing with the highway system. Separate analysis was made for Sacramento and Stockton-oriented systems.

Figure 46 summarizes the results of this process for Sacramento-oriented systems. The potential intercity travel market by county (excluding intercounty trips within the Bay Area) is indicated along with the patronage associated with each system. It also shows the percentage of the potential intercity travel market in each county that each system would attract due to its location. In addition, it shows the percentage of the total intercity potential market (for all counties) attracted by that system. This permits a comparison of the relative attractiveness of each system related to the service it offers to each county.

Systems serving roughly the same areas with levels of service which are not substantially different attract patronage in equivalent ranges--BART 1, Convential Rail 1, and Exclusive Bus 1, respectively, attract 17 percent, 18 percent, and 14 percent of the intercity market with patronages in the range of 29,000 to 38,000 riders per day.

The slight margin of Convential Rail results from it offering better service within Contra Costa County than the BART System, which has several stops on that same route. Also, while the trip totals for these alternatives are similar, the markets they serve are slightly different. BART 1 and Exclusive Bus 1 serve Solano County/Yolo County trips more heavily, while they do not offer equivalent service to trips within Contra Costa County.

The High Speed Grand Transportation (HSGT) system attracts 11 percent of the market or 23,000 riders per day. Despite its higher speeds, (200 mph) it serves less destinations, avoiding the shorter intercity trip market in the I-80 corridor, and thus serves less total trip-makers than Conventional Rail 1 or BART 1. These shorter markets (15-20 miles) as indicated in the intercounty trip matrix of figure make up a substantial component of the total intercity market. At the same time, however, the HSGT serves the pure San Francisco/East Bay to Sacramento traveler the best of all the systems by virtue of its speed. This highlights the critical decision which must be made in planning an intercity transit system--a trade-off between speed and station-spacing (coverage). Figure 47 shows the patronage generated by the relative service offered by the four systems which offer the best Sacramento/Bay Area service.

Comparing BART extensions to Sacramento, it can be seen from figure 46 that the extension from Concord, crossing the Carquinez Straits at Pittsburg with a direct run to Fairfield, does not serve intercity trips which have one end in Napa, Marin or Sonoma Counties. In addition, BART 2 connections into major Contra Costa County population centers are more circuitous requiring use of the slower existing BART service west of Concord. Therefore its Contra Costa patronage is considerably lower than BART 1 when in competition with the automobile.

Exclusive Bus 2 and V/STOL appear to generate similar patronage levels, less than 2 percent of the potential intercity market. This is a result of different factors for each system. Exclusive Bus 2, an express system between San Francisco/Oakland and Sacramento, is thereby limited to trips which can "outbid" the automobile for this trip in terms of cost and service. In addition, this service level is applied to a relatively small share of the total intercity market. The poor performance of V/STOL is related to its high cost and to the access and waiting times which substantially effect its level of service.

In summary, as shown in figure 46 , the systems which compete the most favorably with the automobile appear to attract up to 10 percent of the total intercity travel market. On a geographic basis, the penetration of the intercity travel market by county is in the 25-50 percent range at best for counties at either end of the study area and in the 10-20 percent range for counties in the middle.

X.C. Patronage on Test Systems--Bay Area/Stockton

Limited testing was carried out in this phase of Bay Area/Stockton Systems. The primary purpose of testing Conventional Rail 2 and Conventional Rail 3 was to learn about the relative attractiveness of the "northern" (Oakland/Martinez/Pittsburg/Tracy/Stockton) versus the "southern" (Freemont/Livermore/Tracy/Stockton) routes.

Figure 45 indicates the total intercity market of San Joaquin-Bay Area exclusive of county-to-county movements within the Bay Area. Market potentials for both the northern and southern routes are shown. It should be noted that the total potential is about one-fourth of that for the Bay Area-Sacramento Corridor.

Figure 47

DAILY TRIPS BETWEEN SACRAMENTO AND BAY AREA LOCATIONS (000)

	Peninsula	East Bay	South Bay	Total
Market Potential	1.4	5.4	1.2	8.0
HSGT	0.9	2.4	1.1	4.4
Conventional Rail 1	0.9	2.9	0.2	4.0
BART 1	0.4	1.6	0.2	2.2
Exclusive Bus 1	0.7	1.5	0.2	2.4

Conventional Rail 2 ("northern" route) travels a more circuitous route than Conventional Rail 3, and the travel time from Oakland to Stockton is longer. However, it makes possible feeder connections with the cities to the north in Marin, Solano and Napa Counties, and this partially offsets the lower level of service offered to Alameda county.

The two systems appear to attract a similar patronage, but this masks the fact that Conventional Rail 3 is competing better in the market if served as indicated in figure 47. It serves 20 percent of the market compared to only 14 percent for the other system.

Drawing on the testing experience with the Bay Area/Sacramento Routes it is likely that express bus service will draw patronage in the same range as rail if the assumed speeds can be maintained. Testing during the next phase will investigate other systems.

X.D. Summary

Several key points can be drawn from the initial patronage forecasts for the test systems.

- While there remains considerable uncertainties in the dimensions of the future intercity travel market until more reliable 1995 person trip forecasts can be made, it appears to be large and varied enough to support transportation services in addition to the existing automobile/highway system.

- Of the three major sub-corridors in the Study Area (Bay Area-Sacramento, Bay Area-Stockton, Stockton-Sacramento) the largest, Bay Area-Sacramento sub-corridor has received major attention. The Bay Area-Stockton intercity corridor market appears to be about one-fifth the size of the Bay Area-Sacramento Corridor market.

- Assuming the level of line-haul performance and access service used in testing can be achieved, it is apparent that there is a substantial potential for transit competition with the automobile in the study region for intercity trips.

- The range of test system levels of service, test system locations and test system stop and terminal assumptions show these three variables to be key to system potential.

- Level of service (time, cost and convenience) is the basis for diversion from automobile for a given origin-destination pair. The faster systems on the longest trips are the best competitors

Figure 48

PRELIMINARY ESTIMATES OF SYSTEM PERFORMANCE
San Joaquin-Bay Area Sub-Corridor
(1995 2-way Intercity Person Trip Ends)

	Total Potential Market	Ridership	% Market
Conventional Rail 2	58,000	8,000	14
Conventional Rail 3	44,000	9,000	20

such as HSGT from South Bay to Sacramento.

- Location of the service (stops) in respect to concentrations of potential trip-makers (concentrations of population) is critical to total system patronage. The sizeable Contra Costa County market penetration by Conventional Rail #1 for example is related directly to the fact that the system offered more than one stop in the county.

- Determining level-of-service in terms of competitive line-haul speed and deciding on the number of stops to reach the largest market must be a trade-off since increased coverage means increased terminal to terminal travel time. This trade-off is central to evaluating systems.

- Longer trips benefit most from the higher speed systems with few stops such as HSGT. However, the shorter intercity trip market (Solano to Sacramento or Oakland for example) is sizeable and suggests the need for intermediate stops.

- Local access service to intercity systems multiplies the advantages of the line-haul service offered and can improve coverage. These access systems are "mediators" between the conflicting requirements for speed and market penetration. Optimistic access assumptions were made in this testing.

XI. SENSITIVITY ANALYSIS

The performance of the base line improvements tested during the Schematic Phase and the transport service and socio-economic or environmental effects which obtain as a result are subject to uncertainties involved in a forecasting process.

In this phase as in those subsequent, the assumptions underlying the forecasting process are being varied over reasonable ranges to test the effects of both uncertainty and policy-related variations in the key assumptions on both system performance and system impacts.

The major assumptions involved in system testing relate to three major Areas: behavioral response of potential trip makers in making choices from among the service alternatives available; the performance--costs and times--associated with subsystems of each improvement alternative; the assumed activity distributions--the alternative futures--which dimension the potential travel market in particular geographic areas.

Three improvement alternatives and three typical intercity trip lengths were chosen as those for which to carry out the sensitivity analysis. The trip interchanges chosen were:

- o Alameda County to Sacramento County
- o Solano County to Sacramento County
- o Yolo County to Sacramento County.

The systems chosen for testing were those which showed the greatest patronage:

- o BART 1
- o Conventional Rail 1
- o Exclusive Bus 1
- o HSGT

These four systems were compared with the automobile in respect to the way in which variations in input parameters associated with the behavioral transport subsystem and land-use activity assumptions would affect the relative transit/auto patronage situation.

XI.A. Subsystem Performance

The sensitivity analysis tested the effect of variations in the following parameters on ridership:

- o vehicle operating costs
- o highway speeds
- o terminal time
- o transit fares

Vehicle Operating Costs -- National studies have shown 12¢/mile as an average cost of owning and operating an automobile. This figure varies from 9.4 to 13.6 cents depending on vehicle size. Of the 12 cent average, approximately 5 cents are "out-of-pocket" costs; three cents per mile can be regarded as the average fuel cost per mile, both gas and oil including taxes.

Given the current uncertainty about energy sources and possible increases in the price of gas, increases of 50 and 100 percent in fuel costs were tested. These changes would increase total vehicle operating costs by 12.5 percent and 25 per cent, respectively.

Figure 49 shows the impact of the increase in fuel costs on the patronage associated with the four systems tested most competitive with the automobile. As might be expected, the longest distance trips are effected most strongly. Patronage associated with a 50 percent gas price increase improves in a range of from 35% to 115 percent over the case where current gas prices are assumed. For the short trips, the transit/auto competitive position is not strongly affected. Where gas prices are assumed to double, there is also a small effect on the medium and shorter distance trips.

An additional test was made of reducing total vehicle operating cost to 5 cents per mile which is in the range of the faster transit system costs. This assumption was made to reflect some yet unknown technological breakthrough or is also reflective of the per person per mile costs for cars with 2 or more occupants. This assumption reduced the transit ridership in all but the longest HSGT route to zero.

Highway Speeds -- Highway speeds were assumed to average 55 mph in the non-local portions of the intercity trips. This assumption respects current speed limits, but is necessarily an average reflecting a mix of both peak and off-peak conditions, but weighted towards the average week-day trips.

To reflect the possibility that average highway speeds will deteriorate over the next 25 years, particularly in urban areas, a 35 mph average speed was tested in the sensitivity analysis. Figure 50 indicates the results. As expected for the longer trips, the transit systems would become more attractive compared to the automobile. The increased speed advantage might lead to a tripling of transit patronage for the longer trips.

Even for the middle distance trips, a deterioration in the competitiveness of auto level of service would favorably impact transit patronage with increases up to 50 percent.

Figure 49

EFFECT OF GAS PRICE INCREASES
ON TRANSIT SHARE OF SELECTED INTERCITY MARKETS

(factor of increase)

	SYSTEM							
	BART 1		Conventional Rail 1		HSGT		Exclusive Bus	
Intercounty Trip	50%	100%	50%	100%	50%	100%	50%	100%
Alameda to Sacramento	1.88	1.88	1.88	1.91	1.35	1.35	2.15	2.15
Solano to Sacramento	1.0	1.02	1.0	1.02	1.03	1.04	1.0	1.0
Yolo to Sacramento	1.0	1.01	1.04	1.01	NA	NA	1.08	1.00

Figure 50

EFFECT OF HIGHWAY SPEED REDUCTION
ON TRANSIT SHARE OF SELECTED
INTERCITY MARKETS (55 mph to 35 mph)

(factor of increase)

	SYSTEM			
Intercounty Trip	BART 1	Conventional Rail 1	HSGT	Exclusive Bus
Alameda to Sacramento	3.08	3.08	1.50	3.53
Solano to Sacramento	1.49	1.49	1.51	1.0
Yolo to Sacramento	1.01	1.01	NA	1.0

Terminal Time -- Assumptions about the convenience of access to intercity line-haul transit services are critical to an assessment of their performance comparative to that of the automobile. The question is complicated by the fact that access time is both a function of schedules and the natural dislike that people express towards waiting time. Empirical studies have shown that each minute spent waiting is experienced as a two and one-half minute delay. While the Schematic Phase made necessarily generalized assumptions about access to stations from county population controids, the effect of simulating poor feeder connections and decreased frequency of service can be simulated.

Doubling the terminal time (spent waiting) had a drastic effect on transit patronage, particularly for the shorter trips. Figure 51 indicates the impacts of changes in terminal time. As can be seen, a deterioration in frequency at the potential transit users by over 50 percent in the middle distance trips, up to 90 percent in the short trips and in a range of 50 to 90 percent for the long-distance trips. This variation reflects the difference in line-haul speeds for the systems being tested.

A decrease in terminal times had the severe impact. Ridership for the transit systems was increased for the longer trips, particularly on the slower systems. Exclusive bus, for example, experienced a 116 percent increase for the longer trips.

Change in fares -- The transit equivalent of automobile "out-of-pocket" costs is fares. Fares are extremely situation specific--that is, they cannot be estimated with considerable detailed data about a system. In addition, policy questions such as whether fares should cover operating costs, amortization, etc., are involved.

For this analysis, the fares of all intercity transit systems were considered equivalent except V/STOL. Since it is recognized that the average per seat mile costs do vary among these systems (see Figure 32) the sensitivity analysis tested a 50 percent increase and a 50 percent decrease on each test system.

Figure 52 shows the results of this analysis. For the long-distance trips BART and rail and bus alternatives are extremely sensitive to fare decreases in terms of auto competition. This indicates the importance of fare setting as an intercity transit policy issue. Fare decreases are less significant for the shorter trips.

Fare increases have the greatest impact on potential bus patronage in all distance categories and generally speaking, the greatest impact on short trips with reductions of up to 50 percent.

XI.B. Behavioral Response -- The Value of Time

The key assumption regarding psychology of travel behavior relates to the question of how important time savings are to potential trip makers who

Figure 51

EFFECT OF CHANGES IN TERMINAL TIMES
ON TRANSIT SHARE OF SELECTED INTERCITY MARKETS

(factor of increase)

	SYSTEM							
	BART 1		Conventional Rail 1		HSGT		Exclusive Bus 1	
Intercounty Trip	+100%	-50%	+100%	-50%	+100%	-50%	+100%	-50%
Alameda to Sacramento	.79	1.88	1.0	1.88	.49	1.35	.90	2.16
Solano to Sacramento	.54	1.0	.54	1.01	.55	-	.60	1.0
Yolo to Sacramento	.44	1.01	.44	1.04	-	-	.92	1.07

Figure 52

EFFECT OF CHANGES IN FARES
ON TRANSIT SHARE OF SELECTED INTERCITY MARKETS
(factor of increase)

	SYSTEM							
	BART 1		Conventional Rail 1		HSGT		Exclusive Bus 1	
Intercounty Trip	+50%	-50%	+50%	-50%	+50%	-50%	+50%	-50%
Alameda to Sacramento	.79	2.0	.79	2.89	.49	1.35	.91	2.16
Solano to Sacramento	.54	1.05	.54	1.05	.55	1.37	.66	1.0
Yolo to Sacramento	.43	1.01	.43	1.01	NA	NA	.92	1.12

are choosing between competing modes. In several studies the value of time to individuals has been found to relate to their income, the amount of time being saved and the way in which the time is spent.

Many travel forecasting methods convert both time savings and out-of-pocket costs to a common abstract metric for mode split comparisons. Nonetheless, such a process necessarily involves assumptions about value of time. The average value placed on time is in the $2.80 - $3.00/hour range according to several studies.

While the selection of an average figure begs several interesting philosophical as well as practical issues, the value of 5 cents/minute is commonly used in urban studies.

Little is known about the value of time for intercity travelers. For purposes of sensitivity analysis, therefore, the work trip value of time was held at 5 cents/minute, but the value of time for all other travel purposes was reduced to 2 cents/minute.

Since a change in time value applies to all modes--both auto and transit, the effect of value reductions is derived largely from the comparative amount of time for a given trip associated with competing modes. Figure 53 shows that the effect of this assumption is not visible on the short or medium range trips. However, for the longer trips, the slower modes gain comparative advantage and operating costs beocme a more significant differentiating factor in mode choice. Therefore, both highway and HSGT are at a disadvantage.

XI.C. Alternative Futures

The Alternative Futures provide the level and distribution of future population and employment which are the basis for trip-generation and, therefore, the basic intercity travel market available to competing modes.

The three Alternative Fugures were developed in Part One and are described in detail in Appendices A and B:

- o Alternative Future One--Low growth, Southern "tilt" and dispersed pattern
- o Alternative Future Two--Moderate growth, Northern "tilt," and dispersed pattern
- O Alternative Future Three--Moderate growth, Northern "tilt" and city centered pattern

Figure 54 indicates the relative distribution at the county level of the population and employment associated with each future. The distribution assumptions used by the California Statewide Transportation Study are also shown. As can be seen, the Statewide distribution is most similar to that of Alternative Future Two. The Statewide distribution was used as the basis of trip generation in this analysis. The function of the sensitivity

Figure 53

EFFECT OF CHANGE IN VALUE OF TIME
ON TRANSIT SHARE OF SELECTED INTERCITY MARKETS
(5¢/minute for work trips, 2¢/minute non-work trips)

(factor of increase)

	SYSTEM			
	BART 1	Conventional Rail 1	HSGT	Exclusive Bus 1
Intercounty Trip				
Alameda to Sacramento	1.88	1.88	.95	2.16
Solano to Sacramento	1.0	1.0	1.01	1.0
Yolo to Sacramento	1.0	1.0	NA	1.10

COMPARISON OF ALTERNATIVE FUTURES FORECASTS TO CALIFORNIA STATEWIDE TRANSPORTATION STUDY--1995

FIGURE 54

	1970	1995				1970	1995			
		Population Forecast Alternative Futures			CSTS	Trip 1970	Employment Forecast Alternative Futures			CSTS
	Baseline	#1	#2	#3	1995	Baseline	#1	#2	#3	1995
CORRIDOR REGION	5,725.7	7,922.2	8,680.3	8,680.3	8,680.3	2,350.2	3,252.2	3,641.6	3,684.2	3,777.2
San Francisco Bay	4,630.7	6,393.0	(7,058.1)	7,058.1	7,058.1	1,927.3	2,607.7	2,957.9	3,000.5	3,093.5
Sacramento	803.6	1,132.1	(1,203.6)	1,203.6	1,203.6	307.4	472.6	(502.5)	502.5	502.5
Stockton	291.9	397.1	(418.6)	418.6	418.6	115.5	171.9	(181.2)	181.2	181.2
Counties										
Alameda	1,076.1	1,393.0	1,401.2	1,451.0	1,447.9	457.4	679.6	726.9	773.9	647.3
Contra Costa	558.1	891.4	937.4	923.8	923.8	137.2	204.1	309.1	310.0	275.3
Marin	207.5	287.8	351.4	320.0	370.2	50.7	64.5	98.4	79.0	101.3
Napa	79.7	145.7	227.4	170.7	170.7	25.8	32.2	52.7	36.4	55.2
Placer*	67.6	97.2	(110.1)	93.7	110.1	18.0	33.7	(38.2)	37.2	38.2
Sacramento	637.5	877.0	(919.0)	944.7	919.0	256.3	374.5	(373.0)	397.9	393.0
San Francisco	714.3	722.3	723.4	777.0	727.0	1,198.5	544.6	561.5	573.0	600.1
San Joaquin	290.7	30.1	(418.6)	418.6	418.6	115.5	171.9	(181.2)	181.2	181.2
San Mateo	556.7	746.9	700.7	776.0	700.7	216.3	291.7	268.1	306.2	343.8
Santa Clara	1,074.8	1,576.4	1,579.9	1,576.7	1,933.5	428.7	652.8	669.3	674.1	830.0
Solano	173.6	285.0	479.4	460.2	357.9	54.1	62.1	134.5	119.7	117.6
Sonoma	205.2	344.5	657.3	652.7	426.7	58.7	76.1	137.4	128.2	122.9
Yolo	92.0	157.9	(174.5)	165.0	174.5	33.1	64.4	(71.3)	67.4	71.3

*Roseville District Only

Note: Figures in parenthesis indicate agreement between alternative future and CSTS

CSTS = California Statewide Transportation Study

testing is to determine the differences in transit potential implied by each alternative future.

The most dramatic differences among the futures are not visible at the county level. Therefore, for future analyses, the futures have already been broken down into 43 districts. The forecasting during this phase, however, was carried out at the county level so many of the more important differences among the futures have no effect.

At the county level the major population distribution differences occur between Alternative Future One on the one hand, and Alternative Futures Two (CSTS) and Three on the other, reflecting the northern vs. southern "tilt."

Sonoma, Solano, Sacramento, Alameda, and San Francisco Counties show the greatest absolute differences. Most important for this analysis are the Solano and Alameda County differences..

Between Alternative Futures Two and Three the differences are less visible since they relate more to distribution and density within counties. These differences will become significant in the analyses in later phases. Alameda, Napa, Sacramento, San Francisco, and San Mateo Counties also show significant differences.

On the employment side, major differences between Alternative Future One and Alternative Futures Two and Three are found in Alameda, Contra Costa, Solano and Sonoma Counties. There is little difference between Alternative Futures Two and Three.

Figure 55 shows the effect of the different 1995 futures on the projected patronage for several test systems.

Alternative Future One, a continuation of present trends, develops the lowest transit patronage. This is a result of both the smaller total population and of its dispersed nature. Particularly, in the middle distance trips, the assumptions of slow growth in Solano and Sonoma and Sacramento are on trial.

Alternative Future Two shows the greatest increase in the medium distance trips. This is in response to the fact that the "northern tilt" assumed in this future shows substantial population concentrations in Solano, Sonoma, Napa and Yolo Counties, In addition, a greater regional growth is projected.

Alternative Future Three which concentrates the moderate growth around existing urbanization, does not really show up in the sensitivity testing at the county scale. The major increases are shown for the longest trips. However, a sub-area breakdown during the next phase will indicate that the higher densities and concentrations of this future will have the maximum beneficial potential for transit by improving access.

Figure 55

EFFECT OF ALTERNATIVE FUTURES ON
POTENTIAL PATRONAGE OF SELECTED TEST SYSTEMS

	SYSTEM											
	BART 1			Conventional Rail 1			HSGT			Exclusive Bus 1		
	AF1	AF2	AF3	AF1	AF2	AF3	AF1	AF2	AF3	AF1	AF2	AF3
Intercounty Trip												
Alameda to Sacramento	.98	1.01	1.06	.98	1.01	1.06	.98	1.01	1.06	.98	1.01	1.06
Solano to Sacramento	.81	1.11	1.09	.81	1.11	1.09	.81	1.11	1.09	.81	1.11	1.09
Yolo to Sacramento	.93	.99	.98	.93	.99	.98	.93	.99	.98	.93	.99	.98

XI.D. Summary

- If energy crisis problems continue and cost of fuel increases the market will expand, and expansion will vary directly with length of trip.

- The largest impact on transit ridership results from the reduction in intercity highway speeds. This affect is likely to be smaller than shown because of two items. First, the increased metropolitan transit plans may maintain highway service in those cities, and suburbs. Secondly, intercity travelers will alter their travel patterns to minimize their time in metropolitan congestion. This is particularly so if the four day work week comes into being.

- Increases in terminal time can reduce the ridership particularly for shorter trips. It is evident that pilot study attempts to check the market, if offering low frequency of service will gain little of the potential of a full system of transit.

- Changes of fare having broad policy impacts involving decisions on subsidy both of capital and operation.

- Alternative Futures implying greater aggregate population and more concentrated patterns will increase transit ridership. More fine-grained analysis is necessary on this point.

XII. EVALUATION

Evaluation is a major issue in itself. Since transportation has no intrinsic value other than as it furthers the social, economic objectives of society, the criteria developed for evaluation should reflect these concerns.

For an intercity transportation study typical urban transportation evaluation categories cannot be applied. New criteria must be developed. These can be drawn from two sources. The first is a recognition of major issues as seen by study participants. Information in respect to these concerns is being developed. The second source of criteria is an analysis of the impacts of prototypical improvements on prototypical activities in the region. Such an impact analysis focuses on the larger scale broad impacts of regional transportation system improvements throughout the region rather than smaller scale local impacts. This analysis, presented below, may serve in addition, to generate additional concerns from study participants.

It will be noticed that the emphasis is not on the typical time savings versus capital cost approach since experience has indicated that such an approach tends to overlook the ultimate purposes of time savings in the first place. Instead, an attempt is made to understand the relationship between the activity structure of the region and the effect on system improvements on that structure.

XII.A. Transport Impacts

The emphasis in this analysis is on the effects of accessibility changes. Discussion of transport impacts is therfore limited to the direct benefit categories for which information is now available. Capital and operating cost data is not yet available other than those generalized figures presented in the analysis of base line technologies. Rate-of-return and other pro forma financial feasibility analysis will not be carried out until the next cycle.

Discussion of direct transport benefits is therefore limited to three categories, diversion, travel time savings and incidence of service:

Diversion

One measure of the impact of new systems on the current study area travel patterns is the effect of diversion of intercity trip-makers from automobile to transit . While the diversion effects on total study region travel are very small the effects on automobile volumes along a particular route can be significant.

The four largest patronage test systems were analyzed for concommitant

Figure 56

EFFECT OF NEW SYSTEMS ON CORRIDOR TRAFFIC
(I-80 CORDELIA EXAMPLE)

	System Patronage	% of Potential	Diverted Vehicle Trips	Traffic Reduction Cordelia (ADT)
BART 1	36	17	28	14,000
BART 2	8	3	6	
Rail 1	38	18	28	14,000
Bus 1	29	14	28	15,000
Bus 2	3	1.6	3	
HSGT	23	11	21	11,000
VSTOL	2	1.1	2	

reduction in average daily traffic across a screen line on the major route between Sacramento and the Bay Area--I-80 at Cordelia. Figure indicates the reductions in traffic associated with the four systems at that point. As can be seen these reductions are in the 14,000-15,000 vehicle per day range. This reduction presently estimated to be about 15 percent of the 1995 volume is true only for that point since different trip length mixes for the various systems tested would result in varying reductions over the length of the major intercity highway routes.

Incidence of Service

An important criteria of transport service is the incidence of service--areas, groups and trip types served by any new system. The systems tested in the Sacramento-Bay Area sub-corridor all serve approximately the same market. However, the station locations and the service levels offered by the new systems combine to offer very different levels of transit competition to the automobile in different locations and for different trip length.

Referring back to figure 46, it can be seen that counties within the service area affected by the test systems evidence quite different trip potentials along the Bay Area-Sacramento sub-corridor. Their geographic position thus affects the ease with which they can be served.

For all intercity trips, the systems with the largest patronage were most effective in Sacramento, Contra Costa, Alameda and San Mateo Counties. These figures result from the definition of the intercity market within the defined study area and result in counties at either end having the longest length intercity trips for which transit is more competitive.

In numbers however, these longer trips are few. Sacramento to San Francisco trips are less than one percent of the intercounty trips along the San Francisco-Sacramento sub-corridor. Even if Conta Costa, Alameda, Santa Clara and San Mateo trips to Sacramento trips are grouped together this is still less than 4 percent of the market.

The counties with shorter intercity trips due to their intermediate positions within the study region constitute an area which, while it is not as well served in terms of the competition offered by transit to the automobile, in absolute numbers still generates a large number of trips. Sacramento-Yolo, Yolo-Solano and Solano-Contra Costa account respectively for 17, 12 and 19 percent of the total intercity market.

The incidence question thus reinforces the importance of the speed/coverage conflict. A new service may be planned to cater to a high percentage of the smaller long-distance market by providing high speeds and few stops. Or, by contrast the service may have four or five stops, sacrificing speed and thus losing a portion of the long-distance trip market to the automobile

but now picking up some of the intermediate trips.

Travel Time Savings

Time savings is the classical engineering travel benefit, to be compared with capital and operating costs in cost/benefit analysis and render a measure of goodness. Time savings, particularly small time savings of the 5-15 minute scale have been questioned as to whether such savings have any intrinsic value other than can be shown to further social or economic objectives. As a result evaluation processes have broadened to contain measures of social and economic impact at both the regional and local scale.

Nevertheless, travel time savings is a useful measure of the relative performance of systems, even if it has less value in an absolute sense. For this round of evaluation three typical trip interchanges of varying lengths have been choosen.

Figure 57 presents the total door-to-door travel time for selected trips along the Bay Area-Sacramento subcorridor. The times presented include access time, terminal time and line-haul running time. Access time is that required to get to the point of departure for the line-haul portion of the trip. This might include a walk to a BART station or bus stop and a 10-20 minute ride to where the intercity system originates. In some cases, it is a drive to a park/ride facility. Terminal time includes waiting at the BART station and waiting for the intercity service.

Since the Schematic analysis has been carried out at the county level, the access times are necessarily generalized. Travel time comparisons between new intercity systems and the automobile will vary according to point of origin in a more detailed analysis.

Travel times on the rail and bus systems are longer than the automobile (traveling within the speed limit) and HSGT and VSTOL are faster. Travel times alone, however are not the basis of mode choice. Cost and convenience are also factors and are factored into mode split decisions. Often cost and convenience factors rather than strict time consumption explain why users may choose a mode which is a few minutes slower. This is the case for those segments of the intercity travel market which make up transit users.

Figure 57

COMPARATIVE COUNTY-TO-COUNTY DOOR-TO-DOOR
TRAVEL TIMES FOR SELECTED INTERCHANGES
(IN MINUTES)

	ALAMEDA/ SACRAMENTO	SOLANO/ SACRAMENTO	YOLO/ SACRAMENTO
BART 1	134	76	51
BART 2	135	76	51
CONVENTIONAL RAIL 1	123	74	50
HSGT	104	71	--
EXCLUSIVE BUS 1	155	83	57
EXCLUSIVE BUS 2	142	--	--
V/STOL	93	--	--
HIGHWAY	115.5	69	45

Figure 58

LINE HALL RUNNING TIME, TERMINAL TO TERMINAL FOR SELECTED INTERCHANGES (IN MINUTES)

SYSTEM	OAKLAND/ SACRAMENTO	FAIRFIELD/ SACRAMENTO	DAVIS/ SACRAMENTO
BART 1	59	33	10
BART 2	60	33	10
CONVENTIONAL RAIL 1	61	27	8
HSGT	29	17	NA
EXCLUSIVE BUS 1	95	41	16
EXCLUSIVE BUS 2	82	NA	NA
V/STOL	20	NA	NA
HIGHWAY	94	49	18.5

The straight line-haul running time component of these total door-to-door travel times tells a different stoy as indicated in figure 58. The new systems largely out-perform the automobile for the line-haul segment of the trip. It can be seen therefore that travel times for potential users who are closer to the intercity system point of origin than the county centroid of population will experience travel times between those of figure 57 and figure 58. Many will experience net travel time savings as well as cost savings. The time savings experienced for trips between given zones of origin and destination can be multiplied by the potential users who would choose that mode to determine total travel time savings.

XII.B. Socio-Economic Impacts

Since the ultimate benefits of transport improvements are people carrying out social or economic transactions, the bulk of the evaluation is oriented towards the impacts of typical improvements on regional activities. The socio-economic impact analysis matrix presented in figure 59 outlines the framework for the analysis. The approach, as shown on the matrix, has been to analyze the impact of each of the major kinds of improvement program components on a series of selected categories of socio-economic units. such as residential activity, recreational activity, the production and distribution of goods and services, the consumption of goods and services, and use of the regional transportation system. A socio-economic unit can be a single person, a household, a business enterprise, or a governmental organization.

In this impact analysis, the region's socio-economic units have been grouped into categories on the basis of the similar kinds of socio-economic activity the units perform and on the basis of the interaction between the units and the regional transportation system. The four major classes into which the socio-economic unit categories have been organized on the impact matrix are:

- Transportation System Users: These are potential trip makers for intercity trips.
- Existing Land Users: These are socio-economic units that have already located their activities somewhere within the transportation corridor, and may be impacted by changes to the regional transportation system serving the corridor.
- Future Activity Locators : These are socio-economic units that will be locating an activity and may be impacted by the opportunities opened up by a new transportation system.

TECHNOLOGY/SOCIO-ECONOMIC IMPACT MATRIX

Socio-Economic Units \ Technology		SHORT RANGE				MIDDLE RANGE				LONG RANGE		
		Auto	Bus	Air	Rail	Highways	Busways	Bart Ext.	Stol System	Dual Mode Guideway	Hi Speed Ground Transp.	[illegible]
USERS	Commuters	⊕	⊕		O	+	O	+		⊕	O	O
	Buisness	O	O		⊕	⊕	O	O	⊕	⊕	+	
	Recreation/ Outdoor	⊕	O	O	⊕	+	⊕	⊕		⊕	O	
	Recreation/ Urban	O	⊕	⊕	O	O	⊕	⊕	⊕	+	+	
	Goods Movers	⊕			⊕		O				O	−
EXISTING LAND USES	Footloose	O		⊕		⊕	O	⊕	⊕	⊕	⊕	+
	Light Industry	O		O		⊕			O	⊕	O	O
	Heavy Industry					⊕		⊕		⊕	O	
	Regional office	⊕		⊕		⊕	O		⊕	⊕	⊕	⊖
	Regional Shopping	⊕	⊕			⊕		⊕		O	O	
	Low Density	⊕				⊕		⊕		⊕		⊕
	High Density	⊕		⊕	O	⊕		⊖	O	O	⊕	⊖
	Public Facilities					O		⊕		⊕	⊕	
	Recreation	⊕	⊕		⊕	⊕		⊕		O	⊕	
FUTURE ACTIVITIES	Footloose	⊕	O	⊕	O	+	⊕	⊕	⊕	+	+	+
	Light Industry	O				⊕		⊕		⊕	O	O
	Heavy Industy					O		⊕				
	Regional office	O		⊕	⊕	O		⊕		⊕	⊕	⊕
	Regional Shopping	O				⊕	O	⊕			⊕	

TECHNOLOGY/SOCIO-ECONOMIC IMPACT MATRIX (CONT.)

	Socio-Economic Units \ Technology	SHORT RANGE				MIDDLE RANGE				LONG RANGE		
		Auto	Bus	Air	Rail	Highways	Busways	Bart Ext.	Stol System	[illegible]	Hi Sp. [illegible] Transp.	Travis-[illegible]/Regional Intern. Air
FUTURE ACTIVITIES	Low Density	⊕			O	⊕	O		⊕	⊕	O	
	High Density	⊖	O	⊕		O	O	⊕	⊕	⊖	⊕	⊕
	Public Facilities	O			⊕	O	O	⊕		⊕	⊕	O
	Recreation	O	O		O	⊕	O	⊕		⊖	⊕	
OTHER FACTORS	Transportation Dependent Population		⊕			⊖	⊕	+				
	Minority/Low Income Res. Patterns		⊕			⊖	⊕	+				
	Property Values		O	⊕		⊕		+	⊕	⊕	+	+
	Agricultural Conversion					⊖		⊖				

- Other special groupings of socio-economic units that may experience special and important kinds of impacts due to changes in the regional transportation system.

The categories of socio-economic units in two of the above classes have been identified on the matrix by the type of land use that the activity of the unit produces.

The emphasis in this analysis has been placed on analyzing the effects of changes in the regional transportation system on the decision of people in the roles they perform as soci-economic units as producers and consumers of social and economic activity. When viewing the transportation system at the regional scale, the primary affect that improvements in the regional transportation system will have on soci-economic units is to improve the accessibility of socio-economic units to other socio-economic units located at other places throughout the region. "Accessibility" in this context means the time, cost, and convenience of moving people and goods from one location to another about the region.

Socio-Economic Units That Produce and Distribute Goods and Services

This grouping of socio-economic units includes both the private enterprise and governmental organization units that produce the goods and services used and consumed by other socio-economic units. The socio-economic unit categories shown on the matrix that are included in this grouping: footloose light industries; other light industries, heavy industries; regional office space developers and managers; regional shipping developers and operators; governmental organizations that develop and operate public facilities. These producer/distributors of goods and services can be further categorized by whether they are existing land users or will be future activity locators.

Existing Land Users -- Producers/distributors of goods and services who have already located their activities at specific locations on the surface of the land throughout the region are affected in several ways by improvements in transportation system accessibility:

- The improved accessibility can give them access to more customers/clients at the same cost, and can lower their selling and distribution costs per unit of product sold.

- Improved accessibility can give them access to more suppliers of their input goods and services at the same cost, and can lower the per unit cost of obtaining the input goods and services they need in their operations.

- Improved accessibility can provide them with access to a larger, high quality labor supply at the same cost to the organization and to the employees of that organization.

- The net effect of the above impacts can be to improve the quantity of economic activity an economic unit can undertake at its existing location and improve the profits realized by private producers of goods and services, and can improve the quantity and quality of goods and services provided by governmental units at the same cost.

- More intense use of the land at an existing location, and higher profitability or productivity of the activity on that land can increase the market value of the land and the improvements on the land (property value).

Future Activity Locators -- Improved regional transportation system accessibility can affect the locational decisions of production/distribution economic units in the following ways:

- New locations can be opened up that will provide the units with the same economic situation offered by existing locations in terms of the size of market for output products, the cost of servicing those markets, the size of markets for input goods and services, the cost of servicing those markets, profitability of operations (private units), and the quantity and quality of output products produced at the same cost (governmental units).

- New locations can be opened up that provide accessibility to the same size and quality of input and output markets, but at lower costs, therefore, improving profit productivity potential.

- New locations may be opened up that provide accessibility to larger, higher quality input and output markets at the same cost with the same or improved profitability/productivity.

- The above impacts can improve the potential for intensity and profitability/productivity of economic activity on new areas of land surface, thereby increasing the market value of those land areas.

Negative Effects -- Improvements in regional transportation system accessibility through the region can have negative effects as well as the positive effects discussed above:

- As far as existing land users are concerned, improved accessibility to other locations throughout the region may divert customers of the existing land users in one part of the region to existing land users in another part of the region. This would degrade the economic situation of the existing land users losing customers/clients, while improving the economic situation of the existing land users to gain new customers/clients.

- Future activity locators who locate their activity in new locations in response to improvements in transportation system accessibility often produce the same kinds of negative impacts described immediately above. Activity created in a new location will often draw customers/clients away from economic units in existing locations. This can produce negative economic impacts on the existing land users, namely: fewer customers/clients, lower revenues, lower profits, and lower property values.

- Changes in accessibility throughout the region may also make certain existing work locations less attractive to the labor force than other existing work locations or to new employment-creating activities started at new locations. This reduces the quantity and quality of the labor force effectively available to the negatively impacted existing land users, ultimately resulting in increased costs to those land users for the inducements necessary to retain the quantity and quality of employees needed.

Residential Land Users -- Residential land users are the household socio-economic units. They perform a variety of social activities and the economic activities of consuming goods and services, and of providing the labor force. Improvements in regional transportation system accessibility produce the following general kinds of impacts on residential land users:

- From the employment standpoint, improved regional transportation system accessibility can give certain households access to more jobs at the same cost and convenience; and can offer lower cost/higher convenience access to the same jobs. On the negative side, if employers relocate due to improved transportation accessibility, the cost of accessibility to the same quantity and quality of jobs may go up; or, at the same cost/convenience, the quantity and quality of jobs available to certain households may decrease.

- Improvements in regional transportation system accessibility to regional shopping centers, regional cultural centers, regional recreational centers and facilities, public facilities, and other households located at longer distances away throughout the region.

- Providing greater accessibility for the households to the kinds of social and economic activities discussed just above can improve the market value of the residential property on which the households reside. On the negative side, however, improved accessibility to certain residential areas in the region can diminish the attractiveness of other residential areas not sharing in the improved accessibility, and can use the property values of this latter class of residential land users to increase less rapidly or even decline.

- Improved regional transportation system accessibility can open new residential areas which provide the same accessibility to jobs, and to other socio-economic centers, and provide the same residential amenities, at lower cost than in existing residential locations.

- Improved regional transportation system accessibility can also provide accessibility to more and higher quality jobs, a higher level of residential amenities and accessibility to more and higher quality socio-economic activity centers at the same cost compared to existing residential areas.

- The improved desirability for residential purposes provided by improved regional transportation system accessibility to certain land areas can improve their market value.

Other Special Groupings of Socio-Economic Units

The Transit Dependent Population -- The transit dependent population is defined as those socio-economic units that must rely on public transportation for movement throughout the region. In general, this includes students, the aged, the poor, and the handicapped, all of whom are frequently too poor to own a car or cannot drive a car for other reasons. They are, therefore, denied access to the regional freeway and arterial system, and must use public transportation. Any improvement in the regional public transportation system, if it is provided at an acceptably low cost, will improve the accessibility of this group of socio-economic units to all types of social and economic activity. In particular, improvements in regional public transportation will provide accessibility to more jobs to the lower income, less skilled households now often constrained to live, partially because of lack of accessibility to a wide range of jobs, in older, deteriorating, inner-city residential areas.

Minority/Low Income Users of Residential Land--These households are often forced to live in less desirable inner-city residential areas because of poor accessibility to jobs and because of discrimination in housing. Improvements in regional transportation system accessibility that cause the creation of appropriate jobs and appropriately priced housing in new locations throughout the region can make the jobs and housing at those new locations accessible to these households.

Agricultural Land Owners--The owners of agricultural and other urbanized land throughout the region often experience substantial increases in the market value of their land due to improvements in regional transportation accessibility that improves the accessibility of their land to existing social economic activity around the region. As accessibility of such land to other socio-economic activity is improved, the desirability of such land for production/distribution and residential activities increases the economic value of the land and drives up its market value.

Selected Impacts of the Regional Transportation System Improvement Program

Figures 59 and 60 graphically indicate the potential impact that the transportation improvement programs could have. The short-range improvement programs will have very little effect, in general, on the categories of socio-economic units included in the impact matrix when viewed in the context of impacts at the regional scale.

Two of the types of middle range transportation system improvements will have substantial impacts on some categories of socio-economic units.

Highway Improvements

Footloose Light Industry -- Footloose light industry is defined, for the purposes of this analysis, as light industrial activity that is in general, constrained in location only by accessibility to a labor supply of adequate quantity and quality. These industries are typically high technology, R & D, and light manufacturing that produces a high value added and that uses low volumes of materials as inputs and produces low volumes of materials as outputs. The input and output flows associated with these industries are often in the form of data rather than in the form of materials. They have great locational flexibility, and as transportation system improvements provide better accessibility to new areas, they often locate in those new areas, many times bringing their own labor force with them. Specifically, for the highway improvements discussed, industries of this kind are likely to locate in increasing number in the Santa Rosa, Napa, Fairfield, Antioch, Brentwood and Livermore Valley/Amador Valley areas.

Other Light Industry -- This category of industry includes the light manufacturing activities that are constrained to locate in closer proximity to suppliers and customers than the footloose light industries. They often handle higher volumes of materials, require higher quantities of input services from other firms in existing activity concentrations, and often provide services to other client firms in existing concentrations. As transportation system accessibility is improved to new areas throughout the region, they will have a tendency to locate in those new areas (the same areas indicated above), as soon as suitably sized concentrations of economic activity have built up at those locations.

Heavy Industry - This type of industry is restricted in location to a few areas by a wide variety of economic and social pressures. This kind of industry is generally incompatible with other kinds of land uses, and is accordingly prevented by public authorities from locating near those other land uses. In addition, this kind of industry generally uses and produces large quantities of materials that must be moved by ship or rail. Improvements in the regional highway system will probably not open any significant new locations for this kind of industry, but could increase the quantity and intensity of activity at existing locations, primarily those

located around the edges of San Francisco Bay, San Pablo Bay, Suisun Bay, and the Pittsburg/Antioch area.

Regional Office Space -- Improvements in the regional highway system may encourage the formation of regional office centers located outside the immediate bay area, where most of the existing regional office space is now located. A great deal of regional type office space activity is now limited only by accessibility to an appropriate labor force and by data transmission facilities, and is thus somewhat footloose. Prime candidates for new centers are Santa Rosa and the Concord/Walnut Creek area.

Regional Shopping -- Improvements in highways will tend to increase the level of activity in existing regional shopping centers in the Walnut Creek, Santa Rosa, Livermore, and Napa areas, and lead to creation of new regional centers in the Fairfield and Brentwood areas.

Low Density Residential -- Improvements in the regional highway system will tend to encourage the development of low density residential subdivisions in new areas around the outlying areas mentioned above.

High Density Residential -- Improved highway accessibility throughout the region will have a tendency to increase high density residential activity in existing nodes, and particularly in some suburban and outlying nodes such as Santa Rosa, Napa, Fairfield, Antioch/Brentwood, and Walnut Creek.

Public Facilities -- The only appreciable impact of an improved regional highway system would be that population-serving public facilities would locate in the areas where new residential activity locates as a result of improved highway accessibility.

Recreation -- Improved highway accessibility of the kind hypothesized will probably have its largest effect on increasing the intensity of recreational use of the Delta area, as well as increasing recreational usage of the Sierras from Yosemite to Lake Tahoe.

An improved regional highway system will have only minor effects on the other socio-economic unit categories shown in the matrix, with one exception. That exception is the agricultural land owners in Sonoma, Napa, Solano, and eastern Contra Costa counties. Improved highway accessibility to agricultural land in these areas will increase the demand for its urban use, and thus increase the market value of that land. A negative impact will be experienced by the transit dependent population in the region, as improved highway access disperses activity more and more throughout the region and makes accessibility to that activity a function of automobile ownership and usage.

BART Extensions

The BART extension improvements will produce effects along their routes similar, in general to those discussed just above for the highway improvements. However, the impact produced by the BART extensions will produce a few different impacts, and some impacts that are generally the same, but

different in a few specifics. The exceptions and the specifics are the following:

- The BART extensions will have a tendency to increase the level of socio-economic activity on the existing land uses in activity centers located close to BART stations. This impact will be created because the BART system, and its stations, will improve the accessibility of a large number of people to the immediate areas of the station as employees and as customers.

- Conversely, the BART Extensions will encourage the location of new socio-economic activity around new BART stations located in areas that are now lightly urbanized or unurbanized. The potential for the greatest location of new activity is around the endpoint of the BART extensions, which are now only lightly urganized. The BART system will provide excellent accessibility to all kinds of new socio-economic activity located along the BART extensions in close proximity to the station.

- In general, the BART extensions will encourage the development of higher density socio-economic activity concentrations around stations in existing urbanized areas, because it will be attractive to some people to avoid making the mode change from BART to automobile or BART to bus. Around the light urbanized ends of the BART extensions, however, the BART extensions will encourage lower density residential development in suburbs where households are willing to accept the mode change from BART to automobile.

- The BART extensions will have a significant beneficial impact on the transit dependent population, since the extensions will provide accessibility to much larger geographical areas and to a much wider range of socio-economic activity for this population. In particular, a large beneficial impact is to be expected for the lower income and minority households now residing in the inner city areas of existing urban concentrations. BART will provide greatly improved accessibility for these households to existing and new employment concentrations located in the suburbs in close proximity to the BART stations.

Long-Range Improvements

The dual mode guideway system option follows a route along Interstate 80. The impacts of such a dual mode guideway system along this corridor will be very similar to those discussed previously for the middle range highway improvements. The accessibility effect of the dual mode guideway, in terms of its impact on the socio-economic unit categories of the impact matrix, is equivalent to great increase in traditional freeway capacity, with attendant reductions in congestion and increased average speeds. The higher average speeds and more convenient service implied by the dual mode guideway system means that the impacts discussed previously for the middle range highway improvements will probably be extended geographically somewhat beyond what traditional highway improvements could create.

The High Speed Ground Transportation (HSGT) link would create a set of impacts having a tendency to reinforce the intensity of activity in the existing urban centers around its stations by improving accessibility to those centers from other locations along the high speed route. In addition, it would encourage the location of new activity along its route at places such as Fairfield and Davis by improving the accessibility of those locations to the existing major urban concentrations of the East Bay area and Sacramento.

Development of Travis Airport Base as an international airport will have its greatest impact on the region immediately around Travis, the Fairfield area. The flow of people and goods created by such a Travis Airport, and the improved nationwide and worldwide accessibility it offers, will lead to concentrations of production/distribution economic units around the airport. Location of these job-creating activities around Travis will stimulate an attendant location of lower density residential development to house the required labor force. This kind of impact produced by a Travis International Airport on the Fairfield area could be substantial. In addition, if improved surface transportation access is provided from Travis to other locations in Solano County, new nodes of residential and nonresidential activity will probably locate along those transportation corridors because of the good access to the Travis/Fairfield transportation and activity concentration. All the categories of Future Activity Locator socio-economic units listed in the matrix except heavy industry would be affected by development of a Travis International Airport, as well as the Existing Land User socio-economic units now located in the Fairfield area. The Travis development would also have a substantial impact on the agricultural landowners in Solano County in the vicinity of Travis.

XII.C. Environmental Impacts

A similar process has been carried out for environmental concerns. Figure 61 indicates a generalized level of environmental impacts which might be associated with the range of possible improvement programs. Without studying improvement options "on-location" little detail can be given.

The evaluation is intuitive and highly subjective. This is necessarily so because of the absence of empirical data. The valuation will, of necessity, always be to a large extent subjective. The system of evaluation uses the present level of impact as a base. Any evaluation of the present level of impact is limited to some generalized identification of issues.

The matrix evaluates only the impact of the suggested change in technology on each environmental factor. No attempt is made to evaluate the impacts of simultaneous technological improvements on individual or collective environmental factors. That is, if high speed ground transportation were

Technology / Factors & Environment	SHORT RANGE				MIDDLE RANGE				LONG RANGE		
	Auto	Bus	Air	Rail	High-ways	Bus-ways	Bart Ext.	Stol system	Dual Mode Guideway	Hi. Speed Ground Transp.	Trans-SST/Regional Intern. Airports
Land Form ...	O	O	⊖	⊖	—	⊖	⊖	⊖	⊖	⊖	⊖
Open Space	O	O	O	O	⊖	⊖	O	O	⊖	⊖	⊖
Soil & Geologic Stability	O	O	O	O	⊖	⊖	O	O	⊖	⊖	⊖
Seismic Conditions	⊖	⊖	O	⊖	⊖	⊖	⊖	O	⊖	⊖	⊖
Surface Water	⊖	⊖	O	⊖	⊖	⊖	⊖	O	⊖	⊖	⊖
Sub-surface Water	⊖	⊖	O	⊖	⊖	⊖	⊖	O	⊖	⊖	⊖
Ocean Water & Bay	O	O	O	O	⊖	O	O	O	⊖	O	O
Drainage Patterns	O	O	O	⊖	⊖	⊖	⊖	O	⊖	⊖	⊖
Climate	O	O	O	O	O	O	O	O	O	O	—
Plants	O	O	O	⊖	⊖	⊖	⊖	O	⊖	⊖	O
Wildlife Habitat	O	O	O	⊖	⊖	⊖	⊖	O	⊖	⊖	⊖
Recreation	O	O	O	O	⊖	⊖	O	O	O	O	⊖
Parks-Reserves	⊖	⊖	O	O	—	⊖	O	O	—	O	O
Historical & Archaeological	O	O	O	O	O	O	O	O	O	O	O
Scenic Views	O	O	O	O	⊖	⊖	⊖	O	⊖	⊖	O
Visual Landscape	O	O	O	⊖	⊖	⊖	⊖	O	⊖	⊖	O
Farm Land Productivity	O	O	O	⊖	⊖	⊖	⊖	O	⊖	⊖	O
Ambient Noise Level	⊖	⊖	—	⊖	⊖	⊖	O	⊖	⊖	⊖	—
Air Quality	⊖	⊖	⊖	⊖	⊖	⊖	O	⊖	⊖	⊖	—

+ Major Positive Impact
⊕ Minor Positive Impact
O No Change in Present Impact
— Major Negative Impact
⊖ Minor Negative Impact

developed in conjunction with pleasant, efficient economical access/egress modes (total interface system) it may be assumed that people would prefer this option to intercity travel. This would reduce use of the private auto for commute and business travel with resulting positive impacts on air and water quality and a host of bio/geophysical environmental factors.

Short range technological improvements center on operational changes and do not involve major construction. Operational improvements are likely to increase number of vehicles and frequency of service. Thus impacts will tend to be secondary with minor negative impacts on water and air quality and increase in noise level. Improvements in operation will make recreation areas more accessible and it is probable that there will be overuse impacts.

Conventional rail improvements would require some new construction which would have a minor negative impact on most geo/biophysical environmental factors.

Middle Range would involve major new construction of systems based on current levels of technology and dependent on fossil fuel energy sources. It may be assumed that the improvements will encourage a high level of increased use. Thus, there will be a broad range of minor negative impacts--both direct (construction related) and indirect.

Long Range will probably be much the same as middle range, though the absence of hard test data makes the evaluation higly speculative.

XII.D. Evaluation Criteria

The regional analysis presented above and the major issues raised in this study together suggest a preliminary list of evaluation criteria for subsequent phases. This list has been composed in response to the concerns expressed by study participants as well as being derived from study team experience. Most of the evaluation criteria require a greater specificity of knowledge about alternatives under consideration than is available at this time. Alternatives at the prototypical level are too generalized for this type of evaluation.

Nevertheless, the categories of concern are those for which the study will be developing information over the next 14 months. They are therefore presented in this report as part of the evaluation framework for discussion along with the prototypical evaluation outlined below.

- Changes in travel time for users
- Incidence of improved travel time by geographic area and socio-economic group
- Change in commutersheds for metropolitan areas
- Trip type (purpose) served
- Connectivity between transport facilities--improved systems operations (park/ride, cross-platform transfer, etc.)
- Service to previously unmet travel demands
- Change in total corridor travel
- Dependence of feeder/distribution services
- Effect on line-haul and local automobile traffic
- Use by transit-dependent for work and other trips
- Change in operating costs (all modes)
- Fare structures required for economic operation
- Improved reliability and redundency of service
- Effect on BART urban operations and patronage
- Safety
- Service to goods movement
- Construction disruption
- Adaptability to changes in technology and staging ability

- Adaptability to changes in demand
- Need for new institutional arrangements
- Likelihood of capital funding assistance (Need for new taxes, special bonds, grants, etc.)
- Improved accessibility to major business, government, cultural, educational and social services
- Comfort
- Convenience
- Construction displacement of households or economic activities
- Right of way costs
- Capital costs

- Multiplier effects on equipment and construction industries
- Impact on efficiency of economic activity
- Change in energy requirements
- Social and economic mobility effects
- Short and long-term effects on employment growth, locations and laborsheds
- Development opportunities created and liklyhood of realization (induced development)
- Effect on historic/cultural places
- Effect on recreation areas and facilities
- Changes in dependency of people on private transportation
- Possibility of joint transportation corridors
- Joint development multiple-use opportunity
- Effect on community/rural character
- Consistency with local planning objectives
- Effects on air quality
- Effect on water quality and quantity, drainage and runoff, ground water level, etc.

- o Effects on vegetation and wildlife
- o Effects of noise and vibration
- o Visual impact on the environment
- o Effects on urban plan

Further discussion and development of this preliminary list must take place to develop a full evaluation framework for later phases.

APPENDIX A

COUNTY EMPLOYMENT

San Francisco County

San Francisco has historically been the major employment center for the region. Although certain types of industries, manufacturing in particular, have been leaving the city or growing up in areas with greater land availability, lower taxes, etc., San Francisco remains one of the three leading employment centers in the region. San Francisco in 1970 had the highest share of employment in the region, but the lowest rate of growth since 1960. In 1970 San Francisco employed 515,230 workers.

Growing up because of its water transportation accessibility it became one of the major distribution centers for the western United States. In 1970 wholesale trade continues to be one of the city's largest employment sectors with 41,230 employees, as does long distance transportaton, employing 21,830. San Francisco also has a high level of federal government employment, being the Western regional office center for most federal agencies. Over 48,600 people were employed in federal and state government in 1970.

San Francisco has become a major office center, particularly for the finance industries. This important industry has grown up in the city, as a result of the location of the Pacific Stock Exchange in San Francisco. Thus, in 1970 in San Francisco 40,420 people were employed in institutional services, and 27,150 were employed in national finance and insurance.

Centralized urban industries (defined above) which benefit by central city locations also make up a significant percentage of San Francisco employment with 20,690 employees.

Local services and retail trade are the two largest single sectors of San Francisco's economy, employing 84,540 and 64,400 workers, respectively. Population-serving industries make up over half of total employment in the city, with local services and retail trade together comprising nearly 30 percent of all employment.

San Francisco will grow much more slowly than the less developed counties in the Bay Area (9 county) region over the next 25 years. Consequently, its share of regional employment will drop significantly, as will its influence within the region.

The industries that are projected to decline in San Francisco are industries that are primarily non-office and have relatively high space requirements such as metal fabrication and machinery, decentralized manufacturing, wholesale trade, and transportation. Decentralized industry will show the greatest decline, San Francisco's share in the Bay Area region (9 county) decreasing from 18 percent in 1970 to about 10 percent in 1995.

San Francisco will remain an important center for finance and insurance, although it will grow more slowly than the region in this type of employment. The city is projected to have 61 percent of the Bay Area's national finance and insurance employment and 38 percent of its local finance, insurance and real estate in 1995 as compared to 66 percent and 47 percent, respectively, in 1970. A projected increase in office space in downtown San Francisco and the development of BART are reasons for San Francisco's continued important role in finance, insurance, and real estate and as an office center in general.

San Mateo County

In 1970 San Mateo County employed a total of 225,020 people, about 11 percent of total Bay Area (9 county) employment. Employment is balanced about equally between basic and population-serving industries. Currently the largest basic employer is long-distance transportation because of the existence of the San Francisco airport in San Mateo County. Long-distance transportation in 1970 employed 27,490 people in this county. Other important basic industries are wholesale trade (19,470 employees), institutional services (13,980 employees), and new technology (11,180 employees).

Retail trade and local services are the two largest single sectors, employing 34,400 and 31,920 employees, respectively, in 1970. Local government is also a major employer with 22,950 workers.

San Mateo County is expected to experience relatively slow employment growth over the next 25 years. Basic industries are projected to increase at a faster rate than population serving industries, accounting for 58 percent of the county's total employment growth. This projected pattern is in contrast to the regional trend.

New technology (defined above) is expected to play an increasingly important role in San Mateo's economy. Between 1970 and 2000 employment in this industry is expected to increase by more than 200 percent. By the year 2000 San Mateo is projected to have 21 percent of the Bay Area's (9 county) new technology employment, as compared to about 13 percent in 1970. San Mateo's growth in this industry is expected to result from its geographic proximity to the large concentration of new technology in northwestern Santa Clara County.

Because of the location of San Francisco Airport in the county, San Mateo should remain a major center for transportation employment. It should approximately hold its position in the region with regard to this type of employment, approximately one-third of Bay Area transportation employment. However, both the region and San Mateo County are expected to grow relatively slowly in this area.

San Mateo also remains an important center for wholesale trade as a result of the location of the Airport. This industry is projected to account for about 8 percent of San Mateo's total employment by 1995.

San Mateo has shown and should continue to show relatively high growth rates in basic services and centralized urban manufacturing, reflecting high regional growth rates in these industries, outside of San Francisco. That is, the area is beginning to be considered as a good alternative urban location to San Francisco, Oakland and San Jose, the historical business and urban industry centers of the Bay Area.

Santa Clara County

Santa Clara County currently contains one of the three major employment centers in the Bay Area -- San Jose northwestward to Palo Alto. During the 1960's Santa Clara experienced a rapid employment buildup as a result of aerospace and related growth in the Palo Alto-Sunnyvale-Mountain View area, which has fallen off considerably since 1969, indicating slower future growth for the county.

In 1970 Santa Clara employed a total of 418,470 people. New technology, primarily aerospace and electronics is the largest sector of the economy as well as the largest basic industry. In 1970 new technology employed 67,230 people. Food and kindred products, centered around San Jose, has also grown rapidly.

The second largest basic sector employing 44,260 people is institutional services, reflecting the office research and new technology development in the county. Other major basic employers are decentralized manufacturing (25,620 employees) metal manufacture and machinery (21,890 employees) and wholesale trade (19,470 employees).

Population-serving industries made up only 47 percent of Santa Clara County employment in 1970 reflecting the high concentration of industrial firms in the county. Retail trade and local services, however, are the second and third largest employers in the county, with 62,410 and 52,030 employees, respectively, in 1970. Educational services are especially important in Santa Clara County because of Stanford University. Additionally a large concentration of medical service employment and research and development firms has developed around the University in the greater Palo Alto area.

Thus in total, services make up about 23 percent of Santa Clara's employment, trade makes up about 20 percent, and new technology makes up over 16 percent.

Employment in Santa Clara County is expected to grow by nearly 100 percent by 1995, an increase considerably greater than the projected overall regional growth rate.

Santa Clara is expected to continue to have the bulk of the Bay Area's (9 county) new technology employment by 1995, but its share will not be as great as it is currently. In 1970 the county had 77 percent of the region's employment in this industry and it is projected to have about 63 percent in 2000. The cutbacks in aerospace employment have significantly slowed Santa Clara's growth in this area.

Local services is projected to be the fastest growing industry in Santa Clara. Growth in local services reflects the county's population and overall economic growth. Santa Clara is also projected to grow rapidly in other population-serving industries, especially local government, construction and retail trade.

The fastest growing basic industries in Santa Clara are institutional services, and centralized urban manufacturing. Santa Clara's rapid growth in these industries reflects the regional rapid growth in these industries, outside of San Francisco, as urban centers in Alameda and Santa Clara County acquire some of the urban oriented industries formerly concentrated primarily in San Francisco.

The only industries which are projected to decline in Santa Clara are agriculture, forestry, and fisheries, decentralized industry, and mining. This trend reflects the continuing urbanization of the county, and the decreasing availability of land necessary for agricultural or heavy industrial uses. Despite the decline in agricultural employment, however, Santa Clara is projected to account for 21 percent of the Bay Area's agricultural, forestry and fisheries employment in the year 2000.

Alameda County

Alameda County in 1970 employed 459,750 workers. It is one of the three counties in which almost three-fourths of the Bay Area (nine county) employment is centered. About half of Alameda County's employment is in basic industries, about an equal number of people being employed in population-serving industry. Of the basic industries the most important are institutional services, employing 43,480; federal and state government, employing 34,840; and metal fabrication and machinery, employing 33,750. The first two have grown up largely around the University of California at Berkeley since it is one of the major area employers

and also the location of the headquarters of the entire University of California System. Metal fabrication and machinery has centered in Alameda County; it has not, however, been an important industry for the Bay Area overall.

Of the population-serving industries retail trade with 68,330 employees; local services employing 64,610; and local government, with 48,030 employees have been the most important employers. Since they are population-serving industries they are not concentrated, but are spread with population.

In general, therefore, government and services dominate the Alameda County economy, together accounting for 41.5 percent of total county employment or 190,960 jobs in 1970. Trade (wholesale and retail) accounts for another 95,140 employees equalling over 20 percent of total employment. Thus, together government, trade, and services account for over 62 percent of Alameda County employment.

Alameda County is expected to continue to be a major center of employment in the nine-county Bay Area region. Employment in this county is expected to increase by over 50 percent between 1970 and 2000, a slightly slower growth rate than that expected for the region as a whole.

Although the Bay Area in general will show a greater growth in service industries compared to basic industries, becoming a more self-sufficient unit, Alameda County expects an increase in basic industries relative to the population-serving industries as the cities in the western part of the county strengthen their positions as regional employment centers.

New technology manufacturing is expected to be the county's fastest growing industry, but it will only account for about 2 percent of total county employment by the year 2000 remaining a minor factor in the county economy. New technology in Alameda County is expected to be more industrial related technology rather than aerospace, as is the case in Santa Clara County.

Institutional services is the second fastest growing industry in Alameda County. By 1995 it will represent 15 percent of county employment, and Alameda County will contain about 30 percent of the Bay Area employment in this group. The increased attractiveness of downtown Oakland as an office location is a major factor in Alameda County's projected increase in basic service employment. Alameda County is expected to remain a major center for metal fabrication and machinery. Available industrial land in the southern part of the county is an important reason for the county's continued growth in this industry. Alameda should represent nearly 50 percent of Bay Area (nine county) metal fabrication and machinery employment by 1995.

Because of Oakland Airport and Port, Alameda accounts for a large portion of the region's long distance transportation employment (19,900 employees) and the county is expected to represent the largest share of the regional growth in this area, as Oakland Airport is expanded.

Wholesale trade and decentralized manufacturing will also be fast growing employment areas in Alameda County, employing approximately 5.6 and 5.2 percent,respectively, of total county employment in 1995, smaller than their percent, respectively, of total county employment in 1995, smaller than their 1970 shares because these industries will not grow as rapidly as new technology, centralized urban industry, metal fabrication and machinery, or institutional services in Alameda County.

Contra Costa County

Total 1970 employment in Contra Costa County was 146,210. This county has not been one of the major areas of regional employment concentrations, representing less than 8 percent of Bay Area (nine county) employment in 1970. Basic industries currently make up about 36 percent of total Contra Costa employment with 64 percent in population-serving industries. By far the most important basic industry in the county is petrochemicals and primary metals. Contra Costa has the greatest concentration of this industry in the region, representing more than one-third of Bay Area petrochemicals and primary metals employment. The oil refineries and other heavy industries along San Pablo Bay and the northern borders of the county, attracted by the water access and available land account for a large part of this employment.

Other significant basic industries in Contra Costa County are decentralized manufacturing and institutional services, employing 8,810 and 6,080 people, respectively.

Population-serving industries represent a much larger share of total employment than do basic industries. Important among them are retail trade, employing 28,940 people; local services, employing 23,820; and local government, employing 20,070 people. Together these three sectors make up about half of total county employment.

Contra Costa is expected to be one of the fastest growing counties in the nine county Bay Area region during the next 30 years. However, it will still be only a minor employment center within the region by 2000, representing less than 10 percent of regional employment at that time.

New technology is projected as the fastest growing industry in Contra Costa, but Contra Costa will not make up a major employment center for this industry, which will concentrate in Santa Clara, Alameda and San Mateo Counties, primarily. Other fast growing industries in Contra

Costa are wholesale trade, population-serving services, basic services, and metal fabrication and machinery. Growth in services will follow Contra Costa's expected continued growth in population, while growth in metal fabrication and machinery reflects the county's attraction for heavy industry and the availability of industrial land.

Contra Costa is expected to continue to be a major center for petrochemicals and primary metals. By 1995 this county should have nearly 35 percent of all regional employment in this industry, the largest share of any of the nine Bay Area counties. However, this industry as a whole is not fast growing and employment in Contra Costa in petrochemicals and primary metals will increase by only between 1 and 2 percent over the next 25 years. A major deepwater port could affect this forecast.

Marin County

Marin County's role in the region has basically been as a bedroom community for the employment centers in San Francisco, Alameda, and Santa Clara Counties. In 1970 total county employment was 56,660, less than 3 percent of the Bay Area (nine county) regional employment. More than 70 percent of Marin County employment has been in population-serving industries, in particular retail trade with 12,880 employees; local services, employing 11,970; and local government, with 8,330 employees. These three industries alone make up nearly 60 percent of county employment.

Only 15,910 people are emplyed in basic industries in Marin County, the three largest basic sectors being institutional services, employing 4,510; federal and state government, employing 3,400; and wholesale trade, employing 2,320 in 1970.

Marin County is expected to continue its suburban role in the region. In 1970 Marin had the lowest proportion of basic employment and the highest proportion of population-serving employment in the Bay Area region, and this trend is expected to continue through 2000. By 1995 nearly three-fourths of Marin's employment will be in population-serving industries.

Marin's employment is projected to increase at a moderate rate over the next 25 years. New technology is the county's fastest growing industry, to employ about 3 percent of total county workers by 1995, which would make it the county's fourth largest basic industry. Wholesale trade will also grow relatively rapidly representing about 4 percent of total county employment in 1995. Basic services also has a relatively high growth rate, and will employ about 10 percent of all workers by 1995.

Other fast growing industries in Marin are population-serving groups such as construction, local finance, insurance, real estate, local services, and local government, all of which depend upon the population growth and relatively high income level of Marin County. In general, there will continue to be few basic employment centers in Marin and population growth will occur because of the attractive living environment.

Napa County

Napa County employed a total of 27,390 people in 1970. Although the county represents only a small portion of regional population and employment, its employment is balanced almost evenly between basic and population-serving sectors, reflecting its relative independence from the employment centers of the region.

Napa County's most important basic employer is agriculture, forestry and fisheries with 3,520 workers. Wine producing forms an important part of this sector. However, due to agricultural mechanization, even though the industry has grown in output over the past decade employment has remained fairly stable. The next largest basic employment sector is federal and state government, employing 3,300 workers in 1970.

The county's two largest employment sectors are local services (5,020 employees) and retail trade (3,910 employees) which serve the local population.

Population-serving industries should make up an increasing share of Napa County employment, accounting for more than 85 percent of Napa's projected employment growth. In all, Napa County should represent only between 1 and 2 percent of total Bay Area employment in 1995.

Construction is expected to be the fastest growing industry in Napa. This increase in construction reflects the relatively rapid population growth projected for the country.

Napa's share of the region's agriculture, forestry, and fishery employment is expected to rise significantly by 1995 even though the industry in Napa will experience negligible employment growth. This phenomenon will occur because agricultural employment in the Bay Area region as a whole is declining. Agriculture employment is expected to decrease in importance in Napa's economy, however, accounting for 6 percent of county employment in 1995, compared to 13 percent in 1970.

In general, then, Napa is not expected to be an area of significant employment attraction. Its population will grow, but it is likely to be employed in other areas of the Bay Region, living in Napa for the amenities offered.

Solano County

Solano County has historically represented a very small percentage of the region's employment except in the agricultural and federal government sectors. Total employment in Solano County in 1970 was 57,710, with 17,480 employees, or more than 30 percent of the total concentrated in federal and state government. The county's two largest employers are the Mare Island Naval Shipyard and Travis Air Force Base.

Local services and retail trade were the next largest employment groups in 1970, serving the resident and the military populations. Next in importance as an employer is agriculture, with 2,690 workers, representing about 5 percent of county employment. Solano does represent, however, more than 7 percent of total Bay Area (nine county) agricultural employment.

Solano County will grow rapidly over the next 25 years, but is not expected to represent a major portion of regional employment in 1995, probably no more than 3.5 - 4.0 percent of the total.

Solano's industry structure indicates a significantly higher proportion of population-serving industries and a lower proportion of basic industries in the year 1995 as compared to 1970. Population-serving industries are expected to represent over 70 percent of total county employment in 1995.

This trend will occur because the only significant basic industries in the county are the military installations, and these are not expected to grow over the next 30 years. At the same time population-serving industries will continue to grow with the population, and these will therefore make up an increasing percentage of total employment.

Petrochemicals and primary metals, construction, local finance, insurance and real estate, and local government are expected to be the county's fastest growing industries between 1970 and 1995. These four industries will probably account for more than 26 percent of county employment by 1995. They are currently developing in the Fairfield area.

Federal and state government employment will probably decrease slightly over the next 30 years, but will continue to be Solano's major basic industry.

Regional air transportation plans suggest the possible development of a commercial air facility at Travis. This development would considerably increase the outlook for employment in Solano County particularly in the long distance transportation, institutional services, wholesale trade,

decentralized industry, and new technology categories. Furthermore, recently industrial developers have expressed increasing interest in the Fairfield and Vallejo areas. Particularly if development to the south of the Bay is restricted, employment growth in the Fairfield and Vallejo areas could be accelerated by as much as 40 - 50 percent.

Sonoma County

In 1970 Sonoma County employment totalled 67,540, representing less than 3.5 percent of Bay Area (nine county) employment. It's most important employers are population serving, mainly retail trade and local services, employing 12,900 and 12,300 people, respectively.

The most important basic industries in Sonoma County both in terms of County employment and regional representation are agriculture, forestry, and fisheries, and decentralized manufacturing. Agriculture is led by the grape growing industry attracted by the climate and soil conditions. Agriculture employed 6,700 workers in 1970. Decentralized manufacture is attracted by the available land and employed 5,250 people in 1970.

Sonoma County is expected to have the highest employment growth rate in the Bay Area region. However, because of its relatively low employment base in 1970, by 1995 it will still account for less than 5 percent of the Bay Area (nine county) region's employment.

The county's industry structure reflects an increasing proportion of service and population-serving industries and a decreasing proportion of basic industries.

New technology, metal fabrication and machinery, and local transportation communications and utilities are expected to be the county's fastest growing industries between 1970 and 1995. However, they will still employ a very small number of people and together account for only 8 percent of the county's employment in 1995.

The three largest employing industries in Sonoma County in 1970 were retail trade, local services, and local government. Employment in these industries should more than double by 1995 because of population growth. At that time they will account for 54 percent of total employment in Sonoma County. This trend reinforces the population-serving nature of the county's industry structure.

Agricultural employment is expected to decline because of mechanization of the industry, although agriculture is likely to remain an important industry in the county. Sonoma will have a growing share of the region's agricultural employment, since agricultural employment will decline more rapidly in the more urbanized counties than in Sonoma.

If development to the south of the Bay is restricted, employment growth in Sonoma County as well as population growth could grow up to one and one-half times as fast as it otherwise is expected to grow. In this

case it is likely that more basic industries would be attracted to the area than in the above case. The Santa Rosa area in particular has begun to attract industries like electronics and decentralized manufacturing which do not require the centralized urban environment.

Employment-- Sacramento Area

The Sacramento area is composed of Sacramento County and those portions of Placer, El Dorado, and Yolo Counties closest to the City of Sacramento. Although these form a metropolitan area around Sacramento City the constituent counties do have some basic distinctions. Taking the region as a whole the most important industry group is government, because Sacramento is the capital city of California. Government employs more than 36 percent of all area workers in 1970 or 108,100 people. Next in importance are services and trade which are partly population-serving industries and partly serve the State government offices and the tourist trade which the State Capital attracts. Together trade and services make up nearly 40 percent of total area employment. Manufacturing made up about 15 percent of total employment in 1960, but by 1970 had lost some significance and now represents only about 8 percent of total area employment.

With the capital of the state located in Sacramento, government will continue to be the leading employer and the mainstay of the local economy. The federal government is also an important employer in the area. About 9 percent of the area's total employment is at the three military bases in the City of Sacramento -- McClellan Air Force Base, Mather Air Force Base, and the Sacramento Army Depot. The unique character of McClellan and Mather may make them more stable than some military bases, but their future employment levels cannot be projected with any degree of accuracy.

Retail and wholesale trade are expected to continue to be a strong and growing factor in the economy, continuing to grow at the same rapid rate as in the 1960's. Services, now the third largest employer in the metropolitan area will continue to be the most rapidly expanding part of the economy. Sacramento has historically had a greater service orientation than the rest of California because of growing up around the State Capital. Services will make up an increasing percentage of area employment through 1995.

As the center of an agricultural area, much of the manufacturing activity in the Sacramento metropolitan area is tied closely to agriculture, with the dairy industry, food packers, and canners all important employers. Over 6,000 people are employed year round in agriculturally related manufacturing, and almost double this number work at the peak of the packing and canning season. This industry should continue to grow through the next 25 years.

Recent trends indicate that the greatest growth in manufacturing will be in medium to light industry such as mobile home and furniture manufacturing. Most of this industry will be attracted to the area from the eastern and mid-western United States, coming to Sacramento because of the good market potential, distribution facilities, and living environment of the Sacramento region.

Agricultural output in the area has maintained high levels. However, mechanization, resulting in dramatically increased productivity has been responsible for decline in farm employment, and agricultural employment is expected to continue to drop.

Education is also an important area employment group. UC Davis employs over 4,000 people and attracts other employers such as research firms and institutes and development industries to the area. The University has created a population and employment center which is growing in importance for the region. Sacramento State College is also a significant employer with 1,500 workers. There are also four community colleges in the area employing a total of 13,740 people.

Although total employment in the Sacramento area is expected to grow at about half the pace of the 1960's, the future growth is expected to be steadier and more diverse with a shift toward the service industries.

Distribution Within The Sacramento Area

Total employment in Sacramento County in 1970 equalled about 250,000. The present employment centers are downtown Sacramento, where the major employers are government, retail trade, and services; McClellan Air Force Base; Sacramento east, where the major employer is manufacturing; and the Arden-Arcade complex, depending on retail and services. The Metropolitan Airport is an additional employment center. The county developed some aerospace industry during the 1950's and 1960's, but this industry fell off around 1963, so that Sacramento experienced neither the employment boom or the rapid decline which occurred in the Bay Area. The most important agricultural products in Sacramento County are field crops, livestock, poultry, and fruit and nuts. Food processing is the leading industry, followed by printing and publishing.

The food processing and printing and publishing industries are expected to grow steadily over the next 20 years. The Rancho Seco area should also show employment growth, as the SMUD (Sacramento Municipal Utility District) reactors are likely to attract other industries based on nucleonics.

Sacramento City's geographic position, accessibility, airport, and port make it an attractive regional collection and distribution center. Its importance as a distribution center will increase in the near future. The city also serves, and will continue to serve, as a communications center for the area, since it houses the largest newspapers, most

television and radio stations, most of the area's telephone network, and headquarters for the postal system.

Most of the employment activity projected for the Sacramento region will center in Sacramento City and County.

Placer County

Placer County in 1970 employed a total of between 18,000 and 19,000 people mainly at Roseville, in transportation and retail, and at Auburn where the county government is located. This county does not represent a major employment center for the region as it is largely forests and mountains, containing the northwestern third of Lake Tahoe. Poultry, livestock, feed crops, and fruit are the leading farm products, with turkeys the leading agricultural industry. Manufacturing activity is dominated by the lumber and wood products industry. Tourism and recreation are also important industries for Placer as it attracts skiers and other winter sportsmen and camping, boating, hunting, and fishing enthusiasts in addition to tourists visiting the gold rush country.

Since Roseville and Auburn are rapidly growing as suburbs of Sacramento, they will continue to be the major population and employment centers for Placer County. The more rural areas will not grow significantly in employment as agricultural and lumber industries are expected to decline. Recreation industries, however, should grow steadily over the next 25 years, but population-serving groups are likely to account for most of the county's employment growth over the next 20 years.

Yolo County

The main employment centers of Yolo County are the Port Authority and industrial centers in east Yolo around the Port of Sacramento; Davis, including the University of California and research industries which have developed around it; and the food processing industries at Woodland, the Yolo County Seat. Growth is expected to occur in connection with the Auburn Dam and to spread along Highway 80 in the direction of Lincoln.

Employment in the port area (west Sacramento) will be mainly in manufacturing and should about double by 1995. The Davis area is also expected to grow rapidly as the University and related employment expand. Davis should become a significant employment center by 1995, more than doubling its current employment level of about 23,500. As population is also expected to grow rapidly in this area, much of the new employment will be in population-serving industries.

El Dorado

In El Dorado County the principal employment center, excluding the Tahoe Basin, is at Placerville. The Placerville area employed about 5,000

in 1970. Although it is the major employment center in the county, Placerville is not a significant employment center for the region. Most employment is population-serving: retail and local government. Some development is expected in the area, but by 1995 Placerville should still be a minor employment area. The lumber industry, an important basic sector for the area,is expected to decline.

Employment--San Joaquin County

San Joaquin County had a total employment level of 18,400 in 1970. The main employment center for the county is Stockton which dominates the county by its size and economic activity. It is the county seat, and is the hub of rail and highway transport. The Port of Stockton is another major employment factor. Trade, manufacturing and public administration activities dominate the economy, with agriculture taking a relatively minor role. There are three military installations: a Naval annex, an annex of Sharpe General Depot, and an Army Aircraft Maintenance service center. Stockton is also important as a hospital and rehabilitation center. The processing of agricultural products (for example Heinz and Ralston Purina Company) dominates the manufacturing sector.

Lodi is the second largest city in the county and is the major trading center for the northern half of the county. It is located in an important grape and wine producing area. Many Stockton workers live in Lodi. Trade and manufacturing dominate its economy. Most manufacturing is in the food processing group; for example, General Mills, Goehring Meats, and Stokeley-Van Camp are located here.

Tracy is the third largest city in the county. Originally a railroad town, Tracy's economic activity has been dominated by farming for many years, with tomatoes being the most important crop. Food processing is an important industry here. The largest employer in the area is the federal government at Sharpe General Depot, which employs about 2,000 workers. Tracy has recently become a residential community for people working in the Livermore area because of good automobile accessibility to the Bay Area via Highways 5, 50 and 580. Other activities in or near the city include: the Deuel Vocational Institute, a correctional institution for young offenders; a non-nuclear test explosion laboratory operated by the Atomic Energy Commission, and a major pumping station for the Central Valley Water Project.

Manufacturing and trade employment levels in the cities and towns of San Joaquin County are approximately proportionate to the population levels, indicating a high degree of population-serving employment. Recently some employment concentration has been shifting away from Stockton towards the Tracy area. Tracy and Lodi are becoming more important relative to Stockton as trade areas.

The most important employment sector in San Joaquin County in 1970 was trade, with 21 percent of total employment. Manufacturing was second with 15.8 percent, and transportation was close fifth with 8.0 percent.

Agriculture, although a strong industry, is declining in employment because of mechanization. As in most areas of California, the services sector of San Joaquin's economy should be the fastest growing in terms of employment. The government sector employment is difficult to predict because of its dependence on military decisions. Manufacturing is projected to grow at a moderate rate.

The Port of Stockton, an important center for the county, has been declining significantly and the influence of the Port in industrial location decisions has lessened. Partly to balance the decreased terminal activity in the Port, emphasis has been put upon expanding the Port's nationwide warehousing and distribution service over the past eight years. It should be able to attract a significant amount of this type of activity in the future through good facilities. For the future, the Port of Stockton will essentially be a satellite port to Oakland transferring containers to barge or truck, the Port of Sacramento having usurped most of the San Joaquin Valley local port activity. The Port of Stockton will continue as a warehousing and industrial park center, but not an important transport center. Stockton's historical role as distribution center for the Mother Lode country has also been partly usurped by Sacramento and other areas, but some federal and state facilities serving the Mother Lode areas will continue to be centered in Stockton such as the State Highway Department District Office and the Federal Aviation Administration.

In general, therefore, San Joaquin County is not expected to experience rapid employment growth over the next 25 years. The two very general types of activity which will be attracted to the county are decentralized manufacturing and processing, and warehousing and distributing. Much land is available for rail oriented and air oriented industry, but truck oriented developed industrial land is in short supply so that air and rail oriented industries will be the ones most attracted to the area in the near future.

Employment--The Delta Region

The Delta Region is a special resource for the San Francisco/Sacramento area. It is an important agricultural and recreational resource with a delicate environmental balance unduplicated elsewhere in California. The Delta is the focal point where the fresh waters of the Central Valley rivers combine with the salt waters of San Francisco Bay.

Rice and asparagus are the major crops in the area. Rice is milled in Sacramento where it is transported by river. The area also serves for sheep and cattle grazing.

Tourists and recreators are attracted to the Delta area for fishing, waterskiing and boating primarily. An estimated 5,700,000 recreation days will be spent in the Delta area in 1973, making it one of California's major recreation areas. During the summer season present facilities are

usually overtaxed. Twenty-five percent of Delta visitors come from Southern California.

The Delta's significance to the region is as a natural resource for agriculture and recreation not as an employment center. In 1970 the Delta region employed about 1,300 people. This level should about double by 1995, so that the Delta will still represent only a small percentage of regional employment.

APPENDIX B

District - Level Implications of Alternative Futures

Below are described county and district-level implications of the alternative futures for those areas where the alternative assumptions imply substantial differences. It should be noted that this discussion is tentative and preliminary, in keeping with the intention of the Schematic Phase Report. It is expected that this analysis will be revised as necessary for the areas of greatest impact during Phase II.

San Francisco--The City is the administrative, office, financial and cultural center of the entire Corridor Region. Population growth has peaked and in fact in the past few years declined as middle income families have moved out of the city to the bedroom suburbs, primarily in San Mateo County. Like most central cities the housing is aged and declined in value so that it has become the home of the poor, the elderly minorities, singles and young couples. Household size has declined dramatically in recent years as families with children have moved out and the city has become attractive to young single persons. The city is undergoing an extensive redevelopment program with the intention of providing new housing and a wide range of income levels, but with a result of upgrading housing rather than expanding it. In 1970 San Francisco had a population of 714,300. The most optimistic forecast for 1995 indicates an addition of 12,700 persons, for and increase of only 1.8%-by far the smallest increase of any district in the Corridor Region. There are only negligible differences between the extreme forecasts for San Francisco and the Northern Tilt would have no impact upon the city itself.

San Mateo County--As one of the older bedroom suburbs of San Francisco, San Mateo County under went its major population growth in the 1950's. The urbanized area between Daly City and Menlo Park is now extensively developed in a wide range of housing types. Recent environmental concerns and controls may result in limiting the possibility for much new housing in the hills facing the Bay or for the possibility of new residential developments on Bay fill. Growth will come through the infilling of presently vacant land with the most notable example being the Visitacion Rancho project proposed for San Bruno Mountain. It can be expected too that residential density will increase significantly in the San Mateo district with the construction of numerous apartment and townhouse projects. The impact of the Northern Tilt will depend entirely on

whether growth is dispersed or city-centered, with the latter resulting in increased employment and population.

Half Moon Bay is located on the Pacific side of San Mateo County extending south of the presently developed Pacifica area. Major housing developments are underway and proposed for Half Moon Bay leading ABAG to project a 200% increase under alternative futures one and two. Study estimates were around 36,000, for the growth of this district is likely to be restricted because of environmental concerns of San Mateo County for the preservation of the hills and Pacific Coast of the County.

Alameda County-- As the home of Oakland, historically the second major city in the Bay Area, Alameda County has developed early as a population center. It is projected for the lowest rate of increase in the Bay Area after San Francisco, (similar to San Mateo). The Alameda district includes the cities of Oakland, Alameda and Berkeley, which are centers for industry, trade, the University of California, and a naval air station which is closing down. The area is largely developed and could grow only through increased density on already utilized land. The city-centered concept of Alternative Future three projects an increase of nearly 80,000 persons, which is in sharp contrast to the 17 to 19,000 person increases projected by Alternative Futures One and Two.

The Castro Valley district includes Hayward and San Leandro and lies immediately south of the Alameda district. The range of forecasts for the alternative futures is remarkably close, totaling only 17,000 and ranging between 14.3 and 20.5 percent. The Northern Tilt concept would have a more significant impact under a city-centered policy. Most additional growth will likely come in Castro Valley as the older areas are developed with little vacant property.

The Fremont district on the East Bay south of Castro Valley and just northeast of San Jose, includes Fremont and Union City and has been a rather fast growing portion of Alameda County. With vacant land remaining and some potentials for Bay fill, the Fremont district is projected for a 42% increase even under Alternative Future Oneand more than doubling under Alternative Future Three. The impact of this city-centered concept on Alameda County is most heavily felt in the Fremont District.

The Amador district lies east of the Fremont and Castro Valley

districts separated from them by a range of hills. The City of Pleasanton and the unincorporated area around Dublin have been growing at remarkable rates, both as bedroom suburban communities and as centers for new employment, primarily in distribution and light manufacturing. The district has severe air pollution and sewage treatment problems. The City of Pleasanton, like the City of Livermore to the east, has had voter imposed moratoriums on growth. These efforts can be expected to continue. Even so, the rate of growth will be spectacular. ABAG projects in its low forecast(Alternative Future One) that the Amador district will add 165,000 persons, an increase of 445%. Under Alternative Future Two, approximating the ABAG Northern Tilt forecast of about the same growth, a population of 15,000 are assumed located in a potential new town in the Pittsburg district of Contra Costa County.

A significant impact would be felt in Amador, however, under Alternative Future Three in comparison to other futures, growth would still occur, but at a lesser rate and to a maximum limit of 100,000. The land use constraints derived through the environmental holding capacity analysis of section IVindicate an additional 50,000 persons can be accommodated in absolutely clear areas, for a new total of 87,000. With infilling and slightly higher densities 13,000 additional people are assumed to be accommodated. At that point, however, land use and airshed problems would combine to limit growth. Those persons and jobs which would have come to Amador will be accommodated along the East Bay, especially in the Fremont district.

The Livermore district includes the City of Livermore and the remaining rural area of eastern Alameda County. The range of Alternative Future projections are much more consistent here than in Amador to the west. The difference between extreme futures is less than 10,000 persons. The city-centered concept of Alternative Future Three would result in a lower population than even the low growth of Alternative Future One. The same environmental constraints exist here as in Amador, although the environmental capacity analysis shows sufficient developable land. These constraints will prevent growth which is restricted in Amador from leap frogging to Livermore, keeping it along the East Bay.

Contra Costa County--Contra Costa County has developed almost as a twin of Alameda County with older development on the East Bay centered around the City of Richmond and new growth to the East over the foothills in Walnut Creek. Unlike Alameda

County, however, the center of population is now in the center of the county rather in the western edge along San Francisco Bay. The Richmond district has been developed as an industrial area and a center of the oil refining and petro-chemical industry for many years. Despite its level of urbanization it is projected for substantial future growth, ranging from 62,000 under Alternative Future One to 137,000 under the city-centered concept. Under this latter Alternative, Richmond would gain while Walnut Creek would lose. Even so, Walnut Creek's current position as the largest population center would be maintained.

The Walnut Creek district contains over one half of the population of Contra Costa County. Unlike Richmond, the Northern Tilt concept would reduce the projected population from even that of the low forecast, down to 46% of the county population under Alternative Future Three. Walnut Creek has sufficient land for development and environmental concerns have not yet had a strong effect on slowing or directing growth.

The Pittsburg district contains industrial and residential development along the south bank of the Sacramento and San Joaquin Rivers. The continuous band of heavy industry has suggested the concept of an "energy corridor" supply increased amounts of gas, electricity, water and transportation along the Bay and River from Richmond to Antioch. This would be especially attractive in the event that a deep water port for petroleum import was located in the Bay Area.

The Brentwood area is a potential location for a new town. Under Alternative Future Two 15,000 persons are allocated to this new town to the Northern Tilt projection of ABAG, leading to a 157% increase over 1970 population.

The city-centered concept of Alternative Future Three would however reduce this growth to 117%, still by far the fastest growth rate in Contra Costa County. Environmental concerns have not yet become influential in the Pittsburg district.

The Black Hills district of Contra Costa County is lightly populated and largely undevelopable. Only 900 to 2,400 persons are projected under any of the Alternative Futures.

The Delta district has 3,600 persons and is projected for a maximum increase of 1,300 persons, largely because the land is subject to flooding and far from basic employment. In none of the districts within Contra Costa County are environmental

concerns currently resulting in significant limitations to growth. The Delta, however, is a concern of the State because of its role in the California Water Plan and its potential for increased recreational activity. A special study group is currently carrying out a planning activity.

Santa Clara County--Under each of the alternative futures Santa Clara County will have the largest population increase of any county in the Corridor region. It is now the largest County in the region and this new growth will reinforce its position as the dominate growth center of Northern California. The San Jose district stretches from Palo Alto on the northwest through Santa Clara and Sunnyvale to the extensive city of San Jose. To the 1,035,500 persons present in 1970, each of the Alternative Futures would add over 500,000 additional persons. The closeness of the forecasts indicates that the growth of San Jose is virtually self-sustaining. The policy decisions relating to the Northern Tilt would hold moderate growth to the level forecast for low growth, but the question of dispersed vs. city-centered growth has little impact on San Jose.

Environmental concerns have not been prominent in San Jose as the urban development has thrown urban sprawl across the Santa Clara Valley. San Jose has annexed substantial areas and provided utility service for extensive development requests. The result has been to create an urban pattern that is used nationwide as an example of highspeed sprawl. In April 1973, however, the voters of San Jose placed a two-year moratorium on new residential units in areas of school deficiencies. It remains to be seen whether this decision will be translated into stronger restrictions on growth. Even with an "urban" expansion line," San Jose would have extensive vacant areas available for in-filling.

The Gilroy district extends south of San Jose and the Santa Clara Valley to the San Benito County line. Extensive new growth will come in this area as it develops as a bedroom suburb of the San Jose district. Gilroy is projected to increase by 128% under Alternative Future One. The moderate growth Alternative Future Two, however, would add new growth in Gilroy (largely taken from the San Jose district). The city-centered concept would hold growth to the range projected for the Low Growth (Alternative Future One).

The Mount Hamilton district includes nearly 1/2 the land area of Santa Clara County, but since it is in undevelopable hills

contains only 1,200 persons at the present time, with no increase projected.

Marin County--Marin County has grown as an upper income residential suburb of San Francisco, with its largest percentage increase coming in the 1950's, matching that of San Mateo County. Growth in the Marin district has been limited by accessibility as the Golden Gate Bridge has been the only tie to San Francisco and by the limited amount of land which has been available for development at reasonable cost. Many new homes have been constructed on the Bay or on rather steep hills which have resulted in a home cost preventing many persons from purchasing in the Marin district. Alternative Future One projects a 40% increase to 283,000 persons while number Two projects a 71% increase to 346,000 persons, as the Northern Tilt is emphasized.

Under Alternative Future Three, the study assumes-despite the Northern Tilt-that the city-centered emphasis would limit Marin County growth to 320,000 persons, which is consistent with the General Plan (calling for 300,000 by 1990). Marin has some of the most beautiful areas around the Bay and the environmental concerns have been strongly expressed for many years. Potentials for restricting growth are most likely to occur-and be successful-in Marin.

The Tomales district includes the northwestern half of Marin County with a very small population of 5,000 at present. Alternative Future one projects a decrease to 4,400 and Alternative Future two and three project only minor increases.

Sonoma County--Sonoma County is the largest county in land area within the Bay Area, extending from San Pablo Bay in the southeast to the Pacific Ocean on the west. Urban growth has been concentrated in the Santa Rosa Valley from Petaluma to Santa Rosa. The Santa Rosa district has land available for extensive growth. This potential has made Santa Rosa the focus of the ABAG Northern Tilt concept. Under this Alternative Future (number two), Santa Rosa would grow by 277,600 or 318% enforcing its position as the dominant city north of San Francisco and in fact becoming the fourth major city of the Bay Area. Under the city-centered concept, Santa Rosa would grow even larger as growth was restricted in outlying districts of the northern counties. The difference between the projected 383,000 under Alternative Future Three and 178,000 under Alternative Future One indicates the extreme.

Santa Rosa is the location of a new electronics plant which will employ nearly 1,000 persons. The decision to allow it and the new possibilities under ABAG forecasts have general concern in Santa Rosa about the impacts of urbanization upon the community. The City is currently developing an urban growth policy. A restrictive policy would conflict with Alternative Future Three.

The Petaluma district, south of Santa Rosa, has been an agricultural area concentrating on poultry. It too has potential for extreme growth under the Northern Tilt concept, with Alternative number Two projecting a 255% increase over the present population of 45,000. This addition of 115,000 persons contrasts with the 35,000 forecast under Alternative number one. The city-centered approach would add 17,000 persons over the dispersed approach. Petaluma, however, is one of the few cities which has already adopted a limitation on its growth, with an ordinance calling for the construction of no more than 500 housing units per year, and some controls over location and design.

The Sonoma district lies in a valley in the Eastern portion of Sonoma County, concentrating on agriculture and especially the production of wines. This district is forecasted to have a much lower population growth than either Santa Rosa or Petaluma, with a maximum of 51% under Alternative Future Two. The range of forecasts is small and policy decisions will have little impact. The limited land available for development and the desire to perserve the vineyards will likely prevent any additional development beyond that forecast.

The Chianti district includes all of rural Sonoma county west and north of Santa Rosa. The valley portions of this district are devoted primarily to pear and apple orchards while the northwestern portion of the district is devoted to recreation and grazing. The difference between the extreme forecasts is rather large considering the small population base at present. The Northern Tilt concept anticipates 48,300 persons being added for a percentage increase of 99%. The city-centered concept limits that growth to 8,100 persons, or 17%. The Chianti district like the remainder of Santa Rosa County is likely to impose limits on growth which may make the forecast impossible to achieve.

Napa County--Napa County is located in the north central portion of the San Francisco Bay Area. It is only one of the nine counties which does not have direct access to the Bay

itself. Its highway access has also been extremely limited to the east and west and access to the urbanized areas of the Bay has been restricted to one bridge over Carquinez Strait. The level land of Napa County has been largely devoted to extensive vineyards, for which it is considered one of the best areas in the world. This emphasis on wine production and the limited access have combined to give Napa County the lowest current population of any in the Bay Area. For the Napa district, which contains the majority of the population in the county, population forecasts range from 93 to 208% to the year 1995. The difference between extreme forecasts is nearly 75,000 persons, ranging from 60,500 under Alternative Future number One to 135,400 under the Northern Tilt concept. The city-centered emphasis would reduce the tilt's impact by over 50,000 persons (Alternative Three versus Two).

Policy decisions by Napa county to retain the vineyards would suggest conflict with this population increase.

The Zinfandel district lies on the northwest portion of the county. With a present population of 13,300, the range of forecasts are from 5,500 to 11,600. These increases are not significant in our study.

Lake Berryessa district contains only 600 persons at present and forecasts for future growth of from 600 to 2,200 persons are insignificant.

Solano County--The final county to be considered in the San Francisco Bay Area is Solano which lies between the Bay itself and the Sacramento area. Several factors are present which indicate that Solano county may be a major center of population growth. The county lies on the Corridor between San Francisco and Sacramento, served by Interstate 80 and the Southern Pacific Railroad. Travis Air Force Base located at the County Seat at Fairfield is a major part of the economy at present and has the potential for being converted to a joint civilian-military use as a fourth regional airport. Finally there is extensive land available within the county even though southeast portions of it are subject to flooding. Solano County desires growth and the attitude of the community is such that much of the Northern Tilt growth projected for Sonoma County could be attracted to Solano instead.

The Vallejo district was an early growth center with both Vallejo and Benicia serving short periods as state capitals of California. The industrial center here is the Mare Island

Naval Shipyard which was founded in 1854. The present population of 83,800 is forecast to increase by 51 to 142% by 1995. The largest increase of 118,700 would come under Alternative Future Three in contrast to the 70,000 increase forecast under Alternative Future Two. Under the city-centered concept Vallejo would be emphasized over Fairfield.

The Fairfield district which contains the County Seat and Travis Air Force Base would be the location of significant population growth under Alternative Future Two which indicates a percentage increase of approximately 377% in contrast to the 248% increase under Future number Three. The Northern Tilt concept includes four new towns of 25,000 population with appropriate basic industry, giving Fairfield the second highest percentage increase in the Corridor Region.

Several major developments are underway in the Fairfield district which contribute to this growth potential:

- Travis Air Force Base is designated in the ABAG Regional Airport Plan as a fourth major airport, serving the northern counties at a rate of 6 million passengers by 1985

- A brewery, industrial park and related tourist attractions are planned at the western edge of Fairfield

- Anderson Ranch, 1200 acres north of Cordelia is a potential for major residential development

- 1500 acres north of Benicia are also under consideration for residential and commercial development

The Vacaville district lying northeast of Fairfield has 33,000 residents at present and could grow as high as 78,300 under Alternative Future Two. Alternative Future One would have a much more limited forecast for Vacaville. Solano County proposes an industrial park adjacent to the Yolo County line, taking advantage of the college and residential attributes of Davis. Davis, however, has indicated concern over the impact on its side of the County line.

The Montezuma Hills district in southeast Solano County includes the City of Rio Vista and much of the land which is not available for development. The 4,100 present residents

are forecast to grow by no more than 500 under the most optimistic forecasts. The North side of the Sacramento River in Solano County presently contains the only vacant land with deep water access. A fabricating plant at Collinsville on the River has been proposed. There are likely to be severe difficulties in providing new port facilities with opposition from environmental concerns.

Yolo County--Northeast of Solano and immediately west of Sacramento lies Yolo County, which is divided into two very distinct parts by the Yolo By-pass of the Sacramento River. In the eastern portion of Yolo County is the West Sacramento district which is a bedroom suburb of Sacramento and serves as a location of the Port of Sacramento and its extensive distribution facilities. The Alternative Futures forecast a rather limited growth for West Sacramento, within the Sacramento area. Futures Two and Three are identical for West Sacramento with each adding 8,100 persons, for a 28% increase compared to the 4,600 persons or 16% increase of Alternative One. The West Sacramento district, however, is the site of a 3,000 acre parcel which is planned for residential and industrial development. Such a development could add a substantial population to the West Sacramento district absorbing much of the growth which is currently forecast for Davis. The major limitations on growth in this district will be the provision of access across the Sacramento River.

The Davis district includes the City of Davis (which contains the University of California at Davis) and Woodland, the County Seat. The present population of 55,600 is projected to increase by 73,100 (132%) under Alternative Future Two. The city-centered concept would cut this by 9000. The city of Davis has placed a moratorium on its growth and hopes to discourage the development of an industrial park across the Solano County line. The City of Woodland has also been concerned about the extent of growth so that Alternative Futures Two and Three may require adjustment. The remainder of Yolo County, which is largely rural agriculture and rolling hills to the west, contains 7,200 persons and at most will increase by 1,500 persons, an insignificant increase.

Sacramento County--Sacramento County is the site of the State Capital, two Air Force bases and extensive developments in new technology. In the past two decades it has grown substantially faster than California as a whole. While this pace will not continue, Sacramento will be the location of the second

largest numerical increase of any district within the region, exceeded only by San Jose. To the present population of 603,600 will be added 266,900 persons, for a percentage increase of 44% under Alternative Future Two. The city-centered concept would increase Sacramento even further, at the expense of Davis and Roseville. The city and county of Sacramento are seriously discussing the potentials for a city/county consolidation. It is unknown what impact this would have on the potentials for growth in the Sacramento district.

The Consumnes district contains most of the rural portions of Sacramento County. While its percentage change forecast of 68% is higher than that of Sacramento it only amounts to an additional 17,500 persons, with little difference under the various alternatives.

The Delta portion of Sacramento County extends down the Sacramento River to the Pittsburg district in Contra Costa County. This portion of the county contains only 4,700 persons and is projected to add at most 400 persons by the year 1995.

Placer County--While Placer County extends from Sacramento eastward over the Sierras to Lake Tahoe, this Corridor study is primarily concerned with that portion of the county immediately adjacent to Sacramento County. This Roseville district contains the cities of Roseville and Auburn, which are heavily oriented to railway transportation and agriculture. The present population of 62,600 is expected increase by 76% to 110,100 in 1995. This will be a growth rate substantially exceeding that of Sacramento itself. The rate would be cut to 55% under the city-centered concept.

San Joaquin County--Centered on the city of Stockton, San Joaquin County has been an agricultural food processing and trade center for the Central Valley. The Stockton district contains 2/3 of the county population, the 180,000 persons are expected to increase by 38 to 44% under Alternative Future two. The city-centered concept assumes that outlying districts will grow only to the Alternative Future One level with all additional growth going into Stockton. While the projections for Stockton are based on rather extensive economic studies there is little new development going into the area and the forecast may be difficult to achieve for that reason.

The Lodi district, lying north of Stockton, is based on agriculture. The 39,800 present population is projected to increase by 15,800 or to 18,500. A rather minor difference and between extreme forecasts.

The Tracy district lies in the southwest portion of San Joaquin County. It is projected to have the highest percentage increase of any district in the county. But on a present base of 21,600 this amounts to a numerical increase of between 10,000 and 11,800 persons only.

The Delta region of San Joaquin County includes the areas west of Stockton and Lodi, containing at the present time only 5,000 persons. This population is expected to fall by 400 persons to 4,600 by 1995.

San Joaquin district of the county contains the remainder of rural and agricultureal areas. The 43,000 population at present is forecast to grow at approximately the same rate as the county as a whole, resulting in a population increase of between 16,700 and 19,400 by 1995.

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